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Is Yours?

On several occasions recently, we have been requested by firms to swear before a Commissioner for Oaths that for a certain period we have mentally associated a trade name with a certain firm's products. We possess no special knowledge of the law of trade marks, but it would appear that they are of value in as much as they prevent the use of colourable imitations by competitors. It would appear that when a trade mark is granted it is only for its use in connection with a line of goods. It may be duplicated in the case of non-competitive materials, as would appear to be the case with "Delta" for leather goods and cork slabs as well as the metal.

One thing which affects the technical Press is that some of these trade names become so popular that they are used indiscriminately—such names as Celophane, Thermos, Nylon readily come to mind. In such cases, if a magazine prints these words without using a capital (and some firms would prefer quotation marks), the Editor receives a reprimand from the owners of the trade mark. One we are constantly encountering is the use of the word Carborundum, for this is a mineral entity in this country but both an American and British trade mark. We invariably change it to "silicon carbide." When some of these words become part and parcel of the English language, the difficulty becomes greater, especially when they appear as verbs. Thus, whilst we can print Sandslinger, we cannot very well accord the courtesy of a capital S to the process sandslinging. Air-less shot-blast machines are only too frequently known by one of the more popular makers and this too is relatively easy to cope with until it reaches the verb stage when, commonly, "to treat castings in a rotary airless shot-blast plant" is replaced by a verb coined from the trade name.

From the above, the importance of trade marks becomes obvious. Furthermore, if it be the policy of a firm so to establish a trade mark that it becomes part of the English language then one word and not two should be chosen. This allows of its change into a process with advantage. "Sandslinging" is a typical case and suggests the initial advantage of choosing a trade name, where processing is involved, of a word finishing in "ing," as has been done in the case of "Bonderizing." The advantage of a trade mark over a Patent is that its life is indefinite and, if the material or process is of real merit, the value of the trade name increases with the passing of the years, whilst the contrary is true of a Patent. For articles destined to be consumed by the public, great thought should be given to the choice of a suitable word for use as a trade mark, as a model may only last a decade. The new model should carry a name which, whilst retaining the goodwill of the earlier one, stresses the novelty of the improvements. This was done effectively in the case of a tool-steel—Speedicut and Speedicut Superior. It certainly appears to us that firms should look into this question of trade names, for quite a number well known in the foundry industry do not seem to be registered. Is yours?

JAMES SHAW

Chairman and Managing Director of Allied Ironfounders, Limited.

Leaders of the Industry

MR. JAMES SHAW

JAMES SHAW, whose portrait is reproduced on the facing page, as chairman and managing director of Allied Ironfounders, Limited, controls the policy of the largest group in this country and probably in Europe of foundries manufacturing light iron castings for the building trades. In the group are no fewer than 22 works practically the whole of which are predominantly foundries. To recall the history of all these firms would be to depict the industrialization of this country from the beginning of the 18th century, but Mr. Shaw, from his office high up in Mortimer House, London, is much more interested in the future than in past achievements and failures. Under his astute guidance, the Company has inaugurated a school for its apprentices engaged in the Scottish foundries, so that there will be no shortage of skilled personnel in the future. Research and development have continually increased in tempo and modern foundry methods applied under his leadership.

Mr. Shaw has reached his present position by the hard route. Leaving school at an early age, he joined the clerical staff at Smith & Wellstood, of Bonnybridge. This was a natural action to take as ironfounding was the sole industry of the town. After ten years at Bonnybridge, like so many other enterprising Scots, he came south—to the Planet Foundry Company, Limited, at Guide Bridge, Manchester. A stay of 25 years saw him progress to the position of managing director. In 1929, when Allied Ironfounders was formed, he became one of the original directors and six years later was appointed managing director. When, in 1943, the late Mr. A. W. Steven, the first chairman, resigned, Mr. Shaw assumed his present position.

The following quotations, taken from "Our Fruitful Heritage," by Basil H. Tripp, give Mr. Shaw's personal policy for the group he controls:—

> 1. We must manufacture in great quantity and in good quality household equipment of all sorts and kinds to meet the different needs of different houses.
>
> 2. We must for ever be inventing and manufacturing household equipment which makes an ever more economical use of the nation's resources and gives women in their homes an even greater economy of labour.
>
> 3. We must be ingenious in manufacturing that equipment so that it can be sold at prices which women can afford to pay; and those prices must enable us to pay our workpeople a fair wage, must give our dealers a fair profit and must give our shareholders a fair return on their investment.

Mr. Shaw has restricted his interests to ironfounding, but has always taken a full share in the work of the trade associations, and has served on the executive committees of both the British Ironfounders' Association and the National Light Castings Federation. In 1950 he became a liveryman of the Worshipful Company of Founders and with it a Freeman of the City of London. As a relaxation from business, golf and fishing are his chief pursuits.

German Foundrymen's Association

Annual Meeting, Düsseldorf, September 25 to 27

The *Verein Deutscher Giessereifachleute* is holding its 43rd annual meeting at Düsseldorf from September 25 to 27. The technical meetings are to be held in the Robert Schumann Hall in the Exhibition grounds. It is expected that the following Papers will be presented:—

"The Question of the Heat Balance of the Hot- and Cold-blast Cupola," by Dr. W. Patterson; "Technical and Economic Aspects of the Production and Use of Foundry Coke," by Dr. H. Wübbenhorst; "Influence of Pig-irons and Scrap on the Quality of Malleable Castings," by Dr. H. Siegel; "Casting of Pig-iron by the Massel (Chill) Casting Machine," by Dr. J. Willems; "Desulphurization of Cast Iron by Means of Limestone and Coke," by Dr. K. Roesch; "Cost Comparison between Basic and Acid Cupola Practice," by Dr. H. Schmidt; "Present Position of Blowing Methods in Cupola Practice," by Dr. H. Krämer; "Notes on the Recent American Convention Tours," by Dr. E. Hugo; "Contribution of the Foundry to Technical Progress," by Prof. H. Jungblut; "Inherited Culture and Creative Impulses in the Technical World," by Prof. H. Deckert; "The Laboratory—Its Construction, Technique and Place in the Foundry Industry," by Dr. Fr. Roll; "Standardized Foundry Training," by Mr. H. Pieper and "What Capital is Needed for Rationalization," by Dr. H. Krippendorff.

During the Convention, visits will be made to the fettling-shop of Eisenwerke Mülheim-Meiderich, which uses no compressed air. A full social programme has been arranged, including a number of enjoyable activities for the ladies. Details of the meeting are available from the V.D.G., Söhmstrasse 70, Düsseldorf.

Index to Vol. 92

The index to Vol. 92, January to June, 1952, of the FOUNDRY TRADE JOURNAL is now ready. Readers who would like an index, and who are not already on the index mailing list, should apply direct to the Publishing Office, 49, Wellington Street, Strand, London, W.C.2. Although the first page of the Index bears the inscription "January to July 1952," it is, of course, the period January to June inclusive which is covered.

J. H. SANKEY & SON, LIMITED, of Aldwych House, Aldwych, W.C.2, have developed and placed on the market a new product—a line of vitrified buff acid and alkali-resisting tiles. Actually, the new product possesses an unusual combination of properties. In addition to being highly vitrified and, therefore, extremely hard and long-wearing, it permanently withstands water, acids and alkalies. The surface of these tiles is non-slippery, whilst the buff colour is light-reflecting.

THE NATIONAL PRODUCTION AUTHORITY of the United States has decontrolled sulphuric acid, and is expected momentarily to relax substantially its restrictions on sulphur. The easing of sulphur controls will increase the 25-day inventory limitation to 60 days. Sulphur supplies in the U.S. have been much improved in the last few months. Since the beginning of the year producers' inventories have increased by 93,000 tons, but users must still not consume more than 90 per cent. of their average monthly consumption in 1950.

Institute of Vitreous Enamellers

Members of the Institute of Vitreous Enamellers who have not yet returned reply forms for the annual conference, to be held in London from October 8 to 11, are warned that the closing date is approaching. Will any who intend to participate please complete this form and return it to the secretaries as soon as possible. The works visits arranged for the afternoon of October 9—one to Watson House and the other to Belling & Company—are alternatives, and it is impossible for any one member to attend both. The visit to Belling & Company is restricted to 36, and any application over this number will be automatically transferred to the visit to Watson House.

Since the programme was printed in the JOURNAL (August 21, p. 200) it has been found possible to include a progress report from the sub-committee working on cast-iron enamelling. This report will be presented on Friday afternoon following the Paper on "Production Methods in the Enamelling Shop." For the ladies' visit to the City of London on October 9, coaches depart from Northumberland Avenue at 2 p.m. and at 2.30 p.m. arrive at the Goldsmith's Hall, where a short talk on the Company will be given. An inspection of the Hall and also the Company's historic and modern plate will follow. At 4 p.m. the party will leave the Hall for the City Livery Club, Zion College, where tea will be served, and at 5 p.m. will return to Charing Cross.

I.B.F. National Works Visits Day

Members of the Institute of British Foundrymen are reminded that the third National Works Visits Day, organized this year by the Wales and Monmouth branch, will take place on Friday, October 24. The programme includes visits to the Steel Company of Wales, Limited, at Margam, Glanmôr Foundry Company, Limited, Richard Thomas & Baldwins, Limited, Brown Lenox & Company, Limited, Goulds Foundries, Limited, Saunders Valve Company, Limited, W. A. Baker & Company, Limited, John Williams & Sons, Limited, and Cardiff Foundry & Engineering Company, Limited. A few vacancies are still available and anyone wishing to participate is requested to complete a reply form and send it to the secretary at Manchester as quickly as possible.

Works Engineers' Refresher Course

The Ministry of Fuel and Power is sponsoring a refresher course on fuel economy at the University of Cambridge Engineering Laboratory, Trumpington Street, from September 22 to 26. The participants are to be housed in Trinity College. Included in the subjects for consideration is the "Economical Use of Compressed Air" by S. Goymour, of Reavell & Company, Limited, Ipswich. Details of the course are available from Mr. J. Woolford, Ministry of Fuel and Power, Brooklands Avenue, Cambridge.

B.B.C. Morning Story

Last Monday morning, there was broadcast a coincidence story called "The Long Arm of the Foundrymen's Gazette," by R. P. Lister, in which a laudatory description was given of the enquiry department of the technical Press. The inclusion of a young lady in a group photograph of a works visit, which was in the files of the "Gazette" but had never been printed, was the basis of the story.

National Foundry College

After consultation between the industry and the Ministry of Education, the National Foundry College was opened in 1948, in order to promote foundry education at a very high technological standard. The college is situated in Wolverhampton, and is housed in the Wolverhampton and Staffordshire Technical College. Excellent hostel accommodation is available. Particular features of the college curriculum are the emphasis on works visits and the employment of numbers of expert visiting lecturers. What follows is a brief resumé of the college set-up followed by accounts of some of the foundries visited this year by the students.

The National Foundry College provides a two-year diploma course designed to equip suitable candidates for executive posts in the foundry industry. A wide range of entrance qualifications is acceptable, provided that the applicant has completed a specified minimum period of training in the foundry industry. In many cases, candidates may not be required to pay the course fees, if their employers are members of appropriate trade associations such as the Council of Ironfoundry Associations, the British Steel Founders' Association, the Light Metal Founders' Association, or the Association of Bronze and Brass Founders, which contribute to the funds of the National Foundry College. Such " sponsored students," as they are known, are in effect seconded by their employers for training at the College. Many British students, and also candidates from India, South Africa, Switzerland, Ceylon, Norway, China and Egypt, have already been trained. The diploma course is unique in the Commonwealth, and covers the whole foundry field. Mould and casting production methods, management problems and foundry metallurgy, rank with estimating and costing as main subjects. In addition, a panel of visiting specialists from the industry give lectures upon subjects of major interest.

Another valuable feature is a series of approximately 70 visits to actual foundries. Throughout the diploma course, one foundry is visited each week and, towards the end of the course, one complete week is spent in visiting a number of foundries in a chosen district. The maximum benefit is derived from these works visits, since all information obtained by individuals is pooled and thoroughly discussed after each visit. No aspect of the foundry industry is neglected, jobbing plants, mechanized plants, those which are devoted to ferrous castings, and those specializing in non-ferrous are all considered. Since 1948, foundries in the London area, Manchester and on Clydeside have been visited, in addition to a very large number of plants in the Midlands. Early in June a number of foundries on Tees-side and Tyneside received a party of students, and were of outstanding interest. In contrast to the other districts visited during the course, apprentice recruitment on the north-east coast appeared to be satisfactory. The group of students participating in this year's visits is shown in Fig. 1.

FIG. 1.—*Party from the National Foundry College, with Officials of the Company, at the Works of Sir W. G. Armstrong Whitworth & Company (Ironfounders), Limited.*

FIG. 2.—*Assembled Segment Castings, for a 9 ft. 6 in. Shaft and Tunnel Connection, produced at the Egglescliffe Iron Foundry of Head, Wrightson & Company, Limited.*

TEESDALE IRON WORKS

The first visit of the series was to the Teesdale Iron Works of Head, Wrightson & Company, Limited, Thornaby-on-Tees. This company are well-known in the chemical-engineering field, and included in their extensive works on Tees-side are two large foundries, at Teesdale and Egglescliffe. The combined output of both foundries is approximately 50,000 tons per annum, consisting mainly of hematite ingot moulds and bottom-plates for the steel industry, cast-iron tunnel-segments and cast-iron railway-chairs and base-plates. In addition, a large tonnage of other types of grey-iron castings is made. The ingot moulds range from between 2 tons each up to 30 tons, while the cast-iron tunnel-segments (Fig. 2), find extensive application in underground railways and power-stations, sewerage and waterworks schemes and range from 5 ft. int. diameter up to 35 ft. The bulk of the ironfoundries division output of railway chairs is taken by British Railways, while the remainder is produced for various industrial undertakings. Slag-ladles for blast-furnace and steel-plant use are also made, as well as various specialized castings for the mining and machine-tool industries.

Head, Wrightson's have been producing steel castings since 1919, when a 3-ton capacity Electro Metals electric-arc furnace was installed in their Thornaby plant. In 1927, Stockton Steel Foundry was acquired and this plant, with the steel foundry at the Teesdale Iron Works, forms the steel-castings division of the Head, Wrightson group. The melting plant of the Teesdale Works now consists of four electric-arc furnaces and two high-frequency induction furnaces (Fig. 3). Tropenas plant is used for steel production in the Stockton Steel Foundry. A wide range of carbon and alloy steel castings is made, ranging from a few pounds weight up to approximately 15 tons. Alloy steel castings are a speciality, and are made in large quantities.

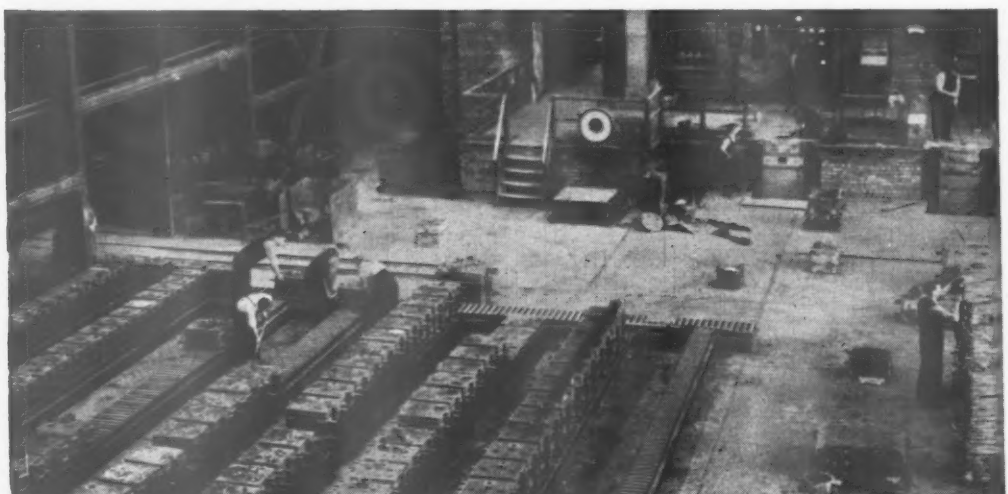

FIG. 3.—*North End of the Induction-furnace Bay at the Teesdale Steel Foundry of Head, Wrightson & Company, Limited.*

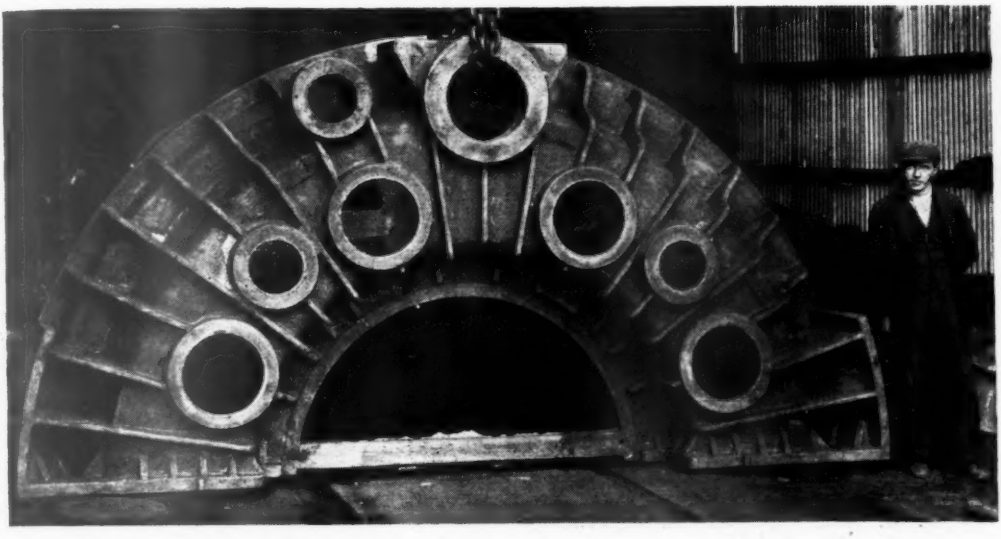

FIG. 4.—*Base Casting for a Gas Generator, One of the Heavier Type of Castings produced in the Jobbing Foundry of Ashmore, Benson, Pease & Company, Limited.*

Features

The Teesdale plant has two outstanding features which may well be unique in this country. Of these, the sand-treatment and handling plant, which was designed and built by the Brassert organization, is one of the largest inspected by students from the College, and has been in regular operation for over 10 years with a minimum of maintenance. The finishing department is equipped with the latest types of shot-blasting plant and annealing furnace and the fettling operations are mainly carried out in the open. The latter feature is not so uncommon as might be imagined in this country, and seems to work quite satisfactorily, so far as the operatives are concerned. The total output of the steel castings division is approximately 12,500 tons per annum.

PARKFIELD WORKS

After luncheon, the party visited the Parkfield Works of Ashmore, Benson, Pease & Company, Limited, in Stockton. The company operates two iron foundries, one being a jobbing shop for the production of castings used in the Group's engineering activities such as blast-furnace construction, and the construction of chemical and gas-works plant and equipment. About 70 per cent. of the output of the jobbing foundry, however, is sold to the engineering trade. The output of this foundry is approximately 100 tons of finished castings per week, and castings up to 20 tons weight are made (see Fig. 4). In addition to the jobbing foundry, there is a semi-mechanized foundry for the production of small, repetitive castings (Fig. 5), mainly for the automobile and textile industries and for agricultural engineering. The output of this foundry is approximately 50 tons per week. The entire output of the foundries is produced in Meehanite—Ashmore, Benson, Pease obtained a licence to make Meehanite in 1933, and were thus amongst the first licence-holders outside the United States.

SIR W. G. ARMSTRONG WHITWORTH & COMPANY

The party then proceeded to the Tyneside area, and on June 10, were received at the Close Works of Sir W. G. Armstrong Whitworth & Company (Ironfounders), Limited, Newcastle-upon-Tyne. These works comprise a roll foundry, producing for the ferrous and non-ferrous industries, as well as most other types (Fig. 6). A large tonnage of refined

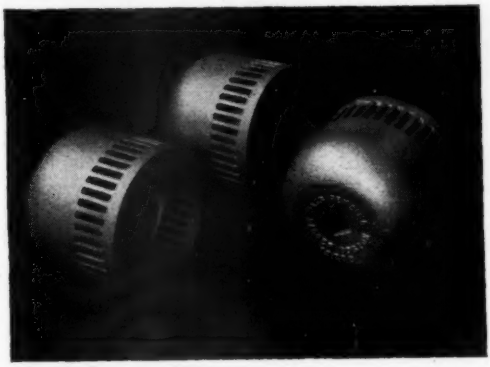

FIG. 5.—*Meehanite Bubble-cap Castings, typical of the Smaller Range produced by Ashmore, Benson, Pease & Company, Limited.*

FIG. 6.—*Roll Production at the Close Works of Sir W. G. Armstrong Whitworth & Company (Ironfounders), Limited.*

pig-iron is produced. In addition, high-duty iron castings of up to 30 tons for general engineering purposes are made (Fig. 7) and turbine and liner castings for Diesel engines are a speciality. The melting capacity of the foundry is provided by one cupola capable of melting 8 tons of iron per hour, one electric furnace of 3-tons capacity, and three air furnaces, each of 18 tons capacity. The Close Works hold a licence to produce spheroidal-graphite cast iron.

In the afternoon the party visited an associated company—Jarrow Metal Industries, Limited. These works are situated some 5 miles from the Gateshead plant and are devoted to steel-castings production. The foundry at Jarrow was built in 1938 and is one of the most modern in this country. The plant is well-designed and is capable of producing a wide range of carbon and alloy steels, individually up to a maximum of 40 tons in weight. The melting capacity consists of one 15-ton capacity direct-arc Tagliaferri furnace (see Fig. 8), and two 8-ton capacity direct-arc furnaces. The Jarrow Works specialize in the production of large marine castings, and in turbine work, and a useful export trade in stainless-steel marine propellors has been developed. All castings are cleaned in a Hydroblast plant. Fig. 9 shows a large steel casting produced at these works.

ELSWICK WORKS

On Wednesday morning, June 11, the party proceeded to the Elswick Works of Vickers-Armstrongs, Limited, Newcastle-upon-Tyne, and concentrated upon the iron and steel foundry. This department is essentially a service department for the engineering shops of the company, and is capable of dealing with steel castings up to 3 tons in weight and iron castings up to 25 tons each. The bulk of the steel-castings production at the present time is intended for munitions, industrial tractors, and also for certain gear assemblies. The iron castings are mainly for printing-press production, tractors, variable-speed gear units and for general engineering. Both the iron and steel foundries are housed under the same roof, in a shop

FIG. 7.—*Water-cylinder Casting, weighing over 3 tons, made in Grey Iron at Armstrong Whitworth's*

FIG. 8.—*Tapping a 15-tons capacity Tagliaferri Basic Electric Furnace at Jarrow Metal Industries, Limited.*

approximately 750 by 150 ft. Steel production is segregated into the west end of the shop and iron occupies the east end. The melting equipment is situated in the middle bay and consists of two side-blown converters of approximately 2 tons capacity each. The iron for the converter plant is supplied from two cupolas adjacent. A separate installation of four cupolas is provided for the iron foundry. The main or middle bay is devoted to floor moulding, and is served by two Sandslingers. In addition, a mechanized foundry section is in operation, consisting of seven jolt roll-over machines, and three plain jolt machines. A knock-out and sand-conditioning plant is provided centrally. The south bay is devoted to green-sand floor-moulding, and a small self-contained mechanized unit consisting of six jolt-squeeze machines with a knock-out and sand plant is also provided here. The cleaning department is quite separate from the foundry and is, in fact, situated at a lower level. Three shot-blast cabinets are provided and the heat-treatment facilities include four large gas-fired furnaces.

FIG. 9.—*Large Steel Casting, Typical of the Heavy Range produced by Jarrow Metal Industries, Limited.*

HEATON WORKS

In the afternoon, the Heaton works of C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, were visited. (The foundries in these works were visited by the members of the Institute of British Foundrymen during the 1951 annual conference, and were then reported in the JOURNAL.) This plant was of great interest to the party, since the shops have been reconstructed at a cost of approximately £300,000 and are among the most recent installations of their kind. The total output of 3,000 tons of castings per annum is obtained from three main units, and is intended for the wide range of engineering products made by this company. In the first unit, light castings up to 100 lb. in weight are made; medium-weight castings up to 5 tons are made in the second unit, and heavy castings up to 40 tons are produced in the third bay. A totally-covered stockyard is situated between the heavy bay and that housing the light and medium sections, and serves two 54-in. dia. and two 24-in. dia. cupolas. In the heavy section, independent, electric, travelling-jib wall-cranes are provided in addition to the normal

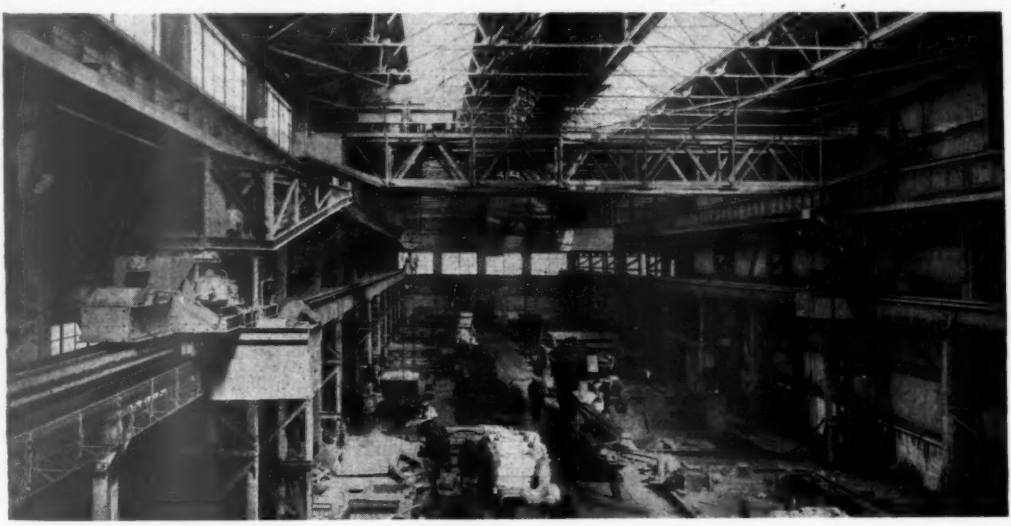

FIG. 10.—*General View of the Heavy Bay at the Heaton Foundry of C. A. Parsons & Company, Limited. Note the Motive-type Sandslinger in the Centre of the Shop.*

overhead types. A large motive-type Sandslinger serves seven moulding pits, and a large sand plant is installed at the end of the bay. The mechanized plant for light castings production is an excellent example of a self-contained unit, and was installed by Foundry Equipment, Limited. Gas is a fuel widely used in these works, and the drying stoves are very well designed. The foundry amenities are excellent, and include modern changing and washing facilities. Figs. 10 and 11 are general views of Parsons' heavy and light foundries respectively.

CHAS W. TAYLOR & SON, LIMITED

On June 12, the South Shields works of Charles W. Taylor and Son, Limited, were visited. This firm operates an iron foundry which is devoted entirely to jobbing work, and has an output of approximately 3,000 tons per annum, of a wide range of castings, including marine propellers up to 19 ft. 3 in. dia., and 23 tons weight. A variety of marine-engine castings is also produced and turbine work is a speciality—castings up to 35 tons being made. The plant is over 60 yrs. old, and is now producing castings of much greater weight and size than was originally intended. The apparent ease with which a high output is maintained in a somewhat limited floor space, reflects very great credit upon the management, and was of especial interest to the visitors. The activities of this firm were described in an admirable Paper given by Mr. C. W. Stewart at the 1951 Annual Conference of the Institute of British Foundrymen and published in the JOURNAL, September 13, 1951.

NORTH EASTERN MARINE ENGINEERING COMPANY

During the afternoon the party proceeded to the works of the North Eastern Marine Engineering Company (1938) Limited, Wallsend-on-Tyne. This company and its associated company Richardsons, Westgarth & Company, Limited operate two large iron foundries, one of which is situated at Wallsend and the other at Hartlepool. The Wallsend plant only was visited; it is producing a wide range of castings for marine-engineering applications, including cast-iron marine propellers. Lanz Perlit iron is used for high-duty applications in these works. It is significant that this process, first used in this country about 27 yrs. ago, is still being used, operating successfully in what is now the very competitive field of high-duty iron-castings production. The company hold a licence for the production of spheroidal-graphite iron, and experimental work is proceeding. (The iron foundries of this company were described in the JOURNAL for June 21, 1951, and formed the subject of one of the visits made by the Institute of British Foundrymen during the 1951 Annual Conference.)

NOBLE & LUND, LIMITED

The final visit was to the works of Noble & Lund Limited, of Felling-on-Tyne. This plant is devoted entirely to the production of machine-tools. Special-purpose machines are frequently produced, and a wide range of this company's standard products, such as cold-saws, etc., find considerable application in the general engineering industry.

The National Foundry College is indebted to the many firms and individuals who have provided facilities for works visits. Such are invaluable for implementing the work in the lecture rooms, and demonstrate effectively the interest and goodwill shown the College by the whole industry.

FIG. 11.—*Section of the Light Iron Foundry of C. A. Parsons & Company, Limited. This has quite recently been Rebuilt and Mechanized.*

Flexible Cutting-off Wheels

By C. A. J. Timms

The operation which creates the main problem in the non-ferrous dressing-shop, is that of the removal of runners and risers. Many different methods are used dependent on the size of the casting or section of runners, gates and risers, and, following a survey of available methods, the Author particularly describes the newly-developed flexible cutting-off wheels for that purpose.

Among the methods available for removing runners and risers from non-ferrous castings there may be listed the guillotine; hand-operated hack-saw; the continuous band-saw or stationary mechanical saw; an abrasive-wheel cutting-off machine (using the non-flexible wheels normally available in Great Britain); pneumatic hammer and cross-cut chisels; oxy-acetylene flame, boosted by the metallic-powder process, and, finally, electric methods, such as the carbon-arc or steel-arc, high-current (500 amps.) cutting-off process.

For small castings which are made on spray runners and where the section of the ingate is say, up to a maximum of ¼ in. thick where it enters the casting, the modern guillotine with a short jaw distance and rapid action is the fastest and most economical technique for runner and riser removal. In all the American foundries visited, the guillotine was universally used for work of this type. When the section of the ingate exceeds ¼ in. the guillotine to be used needs to be increased considerably in size and becomes a rather ungainly machine with a slow action and haphazard cut, leading to excessive grinding losses. For this type of casting, the continuous band-saw may be used, even for thicknesses of cut above ¼ in. but the slowness of the method in conjunction with the considerable expense of saw-blades make this method, particularly on bronze, not very satisfactory. The abrasive-wheel cutting-off machine, as developed in this country over the past few years, is very efficient for the cutting off of these small-section ingates which are such a size that the operator is able to hold the work in his hand loosely supported from the machine table. Since only the extreme edge of the abrasive wheel is used in the cutting action, little stress is put on to the wheel itself.

Cutting of Heavier Sections

When consideration is given to the removal of runners and risers of heavier section, from approximately 1 in. square section up to, say, risers of the order of 8 in. by 4 in. or over, then removal by the methods available in Great Britain at the moment can be very much improved. For these larger sections, the usefulness of the methods already mentioned is to some degree restricted. Obviously, the size of riser and runner increases only with the increase in the size of casting, and therefore, difficulties in handling present themselves, so that the only common methods of removal of these larger sections is by pneumatic hammer and cross-cut chisels, hack-saw, sledge-hammer, and other similar improvised methods, which are used because no other more satisfactory alternatives at present are commercially available.

The most promising method seen in America to cope with this problem is by the use of abrasive cutting-off machines suitably designed to use a flexible unbreakable cutting-off wheel. British machines that have been developed over the last few years have been designed around the only then available abrasive wheel, which had no flexibility and, therefore, no resistance to shock or deflection. Because of this, machines were built with considerable rigidity and allow of no free movement in any direction of the cutting wheel, other than up and down. These machines operate with a wheel peripheral speed of around 15,000 to 16,000 ft. per min., and because of this and their complete breakdown under the slightest deflection load, the work has to be rigidly fixed to the work table. Therefore, the type of work which these machines can handle is extremely limited and generally makes them useless for the purposes of the jobbing foundry requiring to cut-off heads and runners from the larger type of castings. Furthermore, the weakness of the non-flexible abrasive wheel causes fear in the mind of the operator and the machine tends to be used even less efficiently than it could be.

Flexible Wheels

The development of the flexible wheel in America has completely revolutionized ideas and technique in the use of this cutting method and cutting-off wheels are obtainable from 5 to 20 in. dia., with corresponding thickness variations and are manufactured by most of the major grinding wheel manufacturers in the United States. The wheels are made flexible by special manufacturing techniques and use of special materials, and are literally unbreakable, since in case of accident or excessive stress, even when the abrasive surface of the wheel breaks, the wheel does not disintegrate, because the resultant loose pieces are held together by woven Nylon reinforcement. This means that the wheels can be used in machines without guards fitted, thus giving the opportunity for free-hand cutting, and a wide field of use is thus opened. The principle of taking and setting the work on the machine which is operative under the old British conditions can be reversed, with a consequently

* Paper presented at the Brassfoundry Productivity Conference at Harrogate. The Author, who is on the staff of Billington and Newton Limited, Stoke-on-Trent, was a member of the Brassfoundry Productivity Team.

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greater application. For instance, wheels of the smaller type can be fitted to a simple hand-operated grinder, which can be used to cut off small runners and risers flush with the casting surface. Additionally, as the cut is taking place, the face of the wheel can grind the lower surface of the cut, so that the riser is removed and the casting is finished at that point, in one operation.

Larger Wheels

The larger size of wheels can be used in a redesigned standard British machine, with a movable head, thus enabling the wheel to move in any direction and, consequently, deal with any type of casting, runner or riser, in any position, without moving the casting to any great degree. For the larger castings, say over a ton in weight, these wheels could be suitably fitted to standard swing-frame grinding machines, where mobility of the wheel would be 100 per cent. in any direction and cutting would be by free-hand movement.

It is estimated that to remove a riser of 8 by 4 in. section by pneumatic-hammer and cross-cut chisel takes, for aluminium- or manganese-bronze, approximately 45 min., and at the same time the cut would be approximately $\frac{1}{2}$ in. wide, resulting in considerable loss of metal in the form of chippings. Also, the cut could not be exactly square with the surface of the casting and further dressing with a flat chisel and/or grinder would be necessary.

Using a 16-in. dia. flexible wheel in a swing-frame grinding machine, this same riser would be cut-off in approximately $1\frac{1}{2}$ min.; the cut would be only $\frac{3}{16}$ in. wide and be made exactly to the casting contour, thus reducing the finishing time.

Applications

For foundries manufacturing aluminium- and manganese-bronze castings in any size, the application of this new cutting-off technique would be extremely beneficial, and would remove what is at present a severe "bottle-neck" in production of finished castings. Negotiations with the leading grinding-wheel manufacturers in this country and also with grinding-machine makers have been carried out by members of the Brassfoundry Productivity Team, and so far, certain developments in the direction of obtaining the flexible wheel have been made. Obviously, an essential is that the industry should adopt this technique when it becomes available, so that the suppliers of wheels and machines have sufficient incentive to produce what is required, at an economic cost. At the moment, 7-, 8-, and 9-in. dia. flexible wheels for the smaller type of pneumatic and electrically-operated hand machines have been made and are being used with success. Of the larger size wheels, a 16-in. wheel has been produced, which has some degree of flexibility, but is not unbreakable. This development makes this wheel more suitable for existing British machines, since the number of breakages and consequent fear in the mind of the operator will be lessened. This is a big step towards the production of a really unbreakable wheel, at which point it will be necessary for the machine manufacturers, in conjunction with the founders, to produce a series of machines of simple design to take the wheel. The cost of a 16-in. dia. wheel as developed at present varies between £3 and £8, as compared with approximately 15s. for the existing standard wheel. The new wheels are now being made by the major British grinding-wheel manufacturers and also may be obtained from German sources.

Powder Burning

There are only two other methods of cutting-off runners and risers of recent development, which are worthy of mention. The first is cutting-off by means of an oxy-acetylene flame with the admittance of a special metallic powder into the flame, a method patented by the Linde Air Products concern of America, for which the apparatus is made in this country by the British Oxygen Company. This process relies on the intense heat created in the oxy-acetylene flame by the burning metallic powder. The plant itself, consists of equipment to inject the powder in a predetermined quantity into a specially-designed burner. By this technique, aluminium-bronze can be cut quite accurately. For instance, an aluminium-bronze riser of 4-in square section can be removed in less than one minute from the time when the flame begins to fuse the surface. The disadvantages of the process, however, at the moment are the difficulty in maintaining continuously correct flame conditions in production, and also at the moment the high cost of the powder makes the process uneconomical. If the cost of powder could be reduced very considerably and the control of the flame could be maintained simply and by an unskilled operator, this process would have considerable future possibilities. Another disadvantage of the flame-cutting technique is that the cut takes place by fusion of the metal in front of the intense flame and not by burning as is the case of oxy-acetylene cutting of steel. Because of this, the width of the cut itself is erratic and uncontrollable and sometimes loss of metal in this way can amount to up to $\frac{1}{4}$ in. in thickness. When the riser is finally separated, a ragged stump of metal remains which has to be removed by further treatment.

The second method of recent development, which seems to have had some success in the United States, but has not been tried in this country as yet, is that of removing risers and runners of large section by means of steel or carbon electrodes working with a current of not less than 500 amps. This technique seems certainly worth further examination by foundries having this type of cutting-off problem.

DISCUSSION

MR. COOKE said he would be very interested to hear if there was a suitable 7-in. machine available in this country, other than pneumatic, as he had not yet found a suitable flexible-shaft machine for the job.

MR. TIMMS, in reply, said the whole point of the Paper was that machine manufacturers would not develop a machine to use such a wheel until there was a completely flexible, unbreakable wheel avail-

able. If the machine manufacturers were given some incentive, they would undoubtedly co-operate to the fullest extent.

MR. D. G. BROWN pointed out that the average portable machine could be adapted, and the difficulty was by no means insuperable. One recommendation he would make was that the machines should be fitted with a 180-deg. guard.

MR. G. WILLIAMS said his firm had tried out two machines: the first made by the Consolidated Pneumatic Company, and the second, a converted pneumatic grinder by Armstrong Whitworth, which they had found most satisfactory, as they had not discovered an alloy which they could not cut. He agreed that it was essential to guard the machine, as operators were inclined to grow careless.

MR. TIMMS, in reply, said a major point to be considered in connection with suitable machines was that, whatever the diameter of the wheel, the peripheral speed should be maintained at a minimum. In round figures, this should not be less than 12,000 to 13,000 ft. per min. Pneumatic machines were therefore not ideally suited for efficient cutting-off, because speeds could so much be reduced by pressure on the work by the operator.

Lasting Qualities

MR. GUNN inquired whether, in view of the large difference in cost between the flexible wheel and the ordinary wheel, there was any difference in the lasting qualities. In other words, assuming that the non-flexible type did not break, would there be more life obtainable from the flexible than from the non-flexible?

MR. TIMMS was of the opinion that if the more fragile wheel worked perfectly and did not in fact break, there would be very little difference between the wearing lives of the two wheels. At the moment, the high price of the flexible wheel was due to the fact that full production had not been achieved, and the price would obviously be reduced as the demand from the industry increased. To pay £7 for the new type of wheel as against 15s. for the old type seemed rather ridiculous, but he had had experience of one or two accidents which had occurred with ordinary wheels, in his own and other foundries, and operators were scared to use the machines and therefore were not cutting efficiently, so that by giving a man a wheel which he could use with more confidence he would get a far greater efficiency from the machine and the price would thus tend to be offset.

Machines Available

MR. WILLIAMS said his firm used non-flexible wheels and cut-off materials, except high-conductivity and chrome/copper, up to 3-in. dia. without much trouble. Also, the Author had mentioned that little use was made of arc cutting in this country, but his firm were finding it quite successful used in conjunction with steel electrodes, although, of course, the wastage of material was rather great.

MR. HUDSON said he presumed the cutting-off machine was fixed and was not used for hand operation or, in fact, held by a man or subject to vibration from a man's arm, and that Mr. Williams' remarks only applied to a specific type of cutting operation.

MR. WILLIAMS said they were cutting half-ton gearwheels quite easily and did not hold them down at all, but simply pulled the head down to the job and a nice clean cut was obtained. They had tried every casting they made with the hand tool and also with the 16-in. fixed-wheel machine, and had experienced no difficulty at all in cutting any alloy. The chrome/copper had been the most difficult, but they had overcome that by speeding up the machine. Using a German machine which was inclined to clog a little, they had found that by speeding it up they could cut every non-ferrous metal. It was always necessary to remember that such tools did not solve all one's problems, and they would not be able to finish all the runners and risers with the small hand tool.

A MEMBER said that when his firm asked for a quotation for a suitable machine, they were told 40 cub. ft. of air per min. was needed, which meant quite a big compressor and would represent a large capital outlay on special equipment. A machine was required which would work off ordinary voltages.

MR. TIMMS replied that there was nothing suitable as yet, because there had been no demand until now, and suppliers could only design the right type of machine when they had the right type of wheels. It was up to foundrymen to tell the machine manufacturers what was wanted. As previously mentioned, peripheral wheel speed was the vital factor in cutting efficiency; therefore the machine was merely a means of ensuring the wheel rotated accordingly, and should be designed as simply and compactly as possible.

The FORMER SPEAKER said he personally wanted about 3 h.p. and about 12,000 ft. per min., though it was not necessarily a matter of power.

Stimulated Interest

MR. D. G. BROWN said that his firm were definitely entering the field, and he knew of two or three who were interested in the type of wheel produced and were proposing to fit it to their machines. As a matter of interest, he had brought along a range of sizes which his firm made, and he would be glad to show them to anyone interested, after the meeting.

MR. HUDSON expressed his pleasure that the equipment manufacturers were at last trying to help founders in this way.

MR. BROWN said that for over seven years his company and their associates had devoted much research to the manufacture of the flexible wheel, but they had found great difficulty in getting the trade to show any interest because of the high cost. They were now getting into production and believed that the wheel would prove to be the answer to many founders' problems.

MR. W. B. KIRKUP said that Vickers Armstrong's had tried the 16-in. silicon-carbide unbreakable wheel, and it had given a very comparable performance to the ordinary cutting-off wheel in an ordinary platform grinder. In fact, they had been so

(Continued overleaf, at foot of column one)

Engineers' Visit to U.S.A.

The largest single party of European technicians ever to visit the United States under the technical assistance scheme organized jointly by the Organization for European Economic Co-operation and the Mutual Security Agency, left Paris by air on August 25 for New York. Altogether 165 leading engineers from 12 European countries, divided into 10 groups, will spend more than a month exchanging ideas with their American counterparts and studying the latest developments over the whole field of engineering. The visit has been arranged in connection with the Centennial of Engineering in Chicago, where 55 leading American engineering societies will mark the foundation, 100 years ago, of the American Society of Civil Engineers.

United Kingdom representatives taking part in the visit are MR. A. L. HARE, chief development engineer of W. G. Allen & Sons (Tipton), Limited, MR. F. H. ALLEN, assistant research director of the Department of Scientific and Industrial Research, and DR. R. C. G. WILLIAMS, chief engineer of Phillips Electrical Limited.

Restrictions on Copper Lifted

Following the approval by the council of the Organization for European Economic Co-operation of the common list of copper usage prohibitions adopted last year by member countries, European manufacturers will now be able to use more copper. Many articles are removed from this list as a result of the improved world supply position of copper and copper alloys, which can now be used for all plating operations and for the manufacture of many articles coming under the headings of builders' and miscellaneous hardware, furniture, and motor-car fittings, together with certain household articles and electrical appliances. Last year, owing to world shortage of copper, O.E.E.C. member countries had agreed to impose identical restrictions on the use of copper and alloys containing 40 per cent. or more of copper.

Flexible Cutting-off Wheels

(*Continued from page 267*)

satisfied that they immediately asked for more, which unfortunately they could not get.

Searching Test

MR. BROWN said his firm could not promise to supply until the job would work properly. However, it was gratifying to find that such reports as they had received had been good. A test had been made in which they had cut half-way through a bar on a rotating machine and then had deliberately displaced the piece ¼ in. off-centre and then had continued the cut and the wheel had withstood the strain.

MR. TIMMS, in summing up, suggested the position at the moment briefly was that the truly unbreakable wheel as used in the U.S.A. had not yet been produced in Europe, therefore cutting-off completely free-hand by suitable machines could not yet be applied. However, wheels with considerable flexibility were now available, and should be made use of by the industry to the greatest extent possible on existing cutting-off machines, since large savings could be made in setting-up time and the operator would work more happily and efficiently because of his feeling of confidence and safety.

Following Export Results

The progress of industrial firms in the quest for export contracts should be recorded in a league table established on the lines of the Football League, said Lord Swinton, Minister of Materials, when opening the Preston (Lancs) Guild Industrial Exhibition recently. He would like to see every firm telling its workers every month what contracts had been won or lost, and what had been the effect of keeping down prices and adhering to delivery dates. The winning and losing of contracts in export matches were by far the most important matches ever played, he declared. The sellers' market had gone for ever, and in the buyers' market price had the last word. Altogether over £1,000,000 worth of goods were on show at the exhibition, which is described as the biggest ever staged outside the British Industries Fair. All the firms participating have factories, branches, or offices within six miles of Preston.

British Company to Develop Labrador?

The formation of a new British company, made up of a number of existing companies, to develop the resources of Newfoundland, and more particularly of Labrador, was suggested by Mr. Joseph Smallwood, Prime Minister of Newfoundland, when he addressed a meeting in London at the end of last month, arranged by the Federation of British Industries, of firms and associations likely to be interested in such developments. Among the minerals known to exist in Labrador, he said, were vast quantities of iron ore and manganese, and there was every reason to suppose, titanium, copper, lead, and zinc. He emphasized that any company undertaking exploration of these minerals should proceed rapidly.

A Century of Shipbuilding

A pictorial review of some of the post-war products of R. & W. Hawthorn, Leslie & Company, Limited, is given in a well-produced publication entitled "Our Ships at Work." It coincides with the centenary of the founding of the firm's Hebburn shipbuilding yard by Andrew Leslie. The St. Peter's Engine Works can claim a much longer history, for Robert Hawthorn founded his business in 1817. The two firms were later amalgamated into the present company. Because of this important milestone in its history, the firm has included in this brochure a brief record of its 100 years of shipbuilding.

Large Rotary Kiln for South Africa

What is claimed to be the largest rotary kiln in the world, destined for the Dominion Iron & Steel Corporation's foundry at Airlie, Eastern Transvaal, was scheduled to arrive in Durban during August. Sections of this kiln will be discharged at Lourenço Marques as it is impossible to transport them by road from Durban. The plant was made at the Krupp works, Essen; its height is 220 ft. and it is 18 ft. in dia.

Steel production in South Wales in July reached a record weekly average of 72,570 tons, compared with 68,440 tons in June and an average of 68,670 tons for the first half-year. The previous highest weekly average output was 72,260 tons in November, 1951. Pig-iron output was also a record at a weekly average of 31,210 tons, compared with 27,220 tons in June, and an average of 26,680 tons in the first half-year.

British Railways carried 186,359 tons of iron and steel during the week ended August 6—the highest figure for five weeks.

Strength, Structure and Composition of Unalloyed Grey Iron*

By H. T. Angus, Ph.D., M.Sc.

(*Continued from page 245*)

COOLING RATE

The assessment of the cooling rate of a casting is most readily carried out on the basis of the volume to area ratio which must be calculated in consistent units—either metric or English. The effect of this ratio on cooling rate can be very simply demonstrated by Fig. 13, which illustrates the effect of position in a casting upon the cooling surface of a unit of fixed size. In this diagram, a unit 2 by ½ by ½ in. (1/16 cub. in.) is considered, both in the centre and at the extreme edge of a plate 12 by 12 by ½ in. In the centre, the unit has two effective cooling surfaces totalling ½ sq in. in area giving a volume to area ratio of $\frac{0.0625}{0.5} = 0.125$. At the edge, there are three effective cooling surfaces totalling 1.0 sq. in. in area and giving a volume to area ratio of $\frac{0.0625}{1.0} = 0.0625$. Thus, from these figures the time taken to cool over a given temperature range should be twice as great in the centre as at the edge. If it is now desired to find the size of test-bar which theoretically will cool at the same rate it is clear that a test-bar ½ in. dia. has a volume-to-area ratio of 0.125, and a bar of ½ in. dia. has a volume-to-area ratio of 0.0625, and the centres of bars of these diameters should therefore cool at the same rate as the centre and edge respectively of the test-plate. The "equivalent diameter" at the centre of the section is therefore ½ in. and at the edge of the section is ½ in. (Fig. 14).

Equivalent Diameter

The equivalent diameter of a given section may therefore be defined as the diameter of a long cylindrical bar whose centre section will cool at the same rate as the casting section in question when cast under standard conditions. It is important to refer the equivalent diameter to the centre portion of a long bar, since the free end of a cylindrical bar is subject to a correction similar to that applied at the edge of a flat plate. At ordinary test-bar dimensions, the equivalent diameter of the free end of a cylindrical bar can be taken as three-quarters the full diameter of the bar (Fig. 15).

All this has been discussed previously by many writers and assumes that at the solidification point:—

(*a*) The total amount of heat to be dispersed is proportional to the weight or volume of the casting;

(*b*) the rate of heat transfer through the moulding material is constant;

(*c*) all the heat is dissipated through the surface area of the casting; and

(*d*) the cooling rate over the casting section in question is constant.

These assumptions are sufficiently valid for thin castings up to, say, ½ to ¾ in. in thickness or 1 to 1¼ in. dia. Assumption (*b*), that the rate of heat loss is constant, however, is only an approximation, and the error involved increases progressively as the section-size increases. This is shown clearly in Fig. 16, which plots graphically the volume to area ratio against time required for cooling from the eutectic to the eutectoid temperature for varying sizes of bar, as taken from published cooling-curves. If the volume-to-area ratio held strictly, then the cooling rate would be a straight line. Actually, however, as the casting increases in section, so the amount of heat that is transmitted to the surrounding sand before initial solidification takes place also increases, and it is obvious that the rate

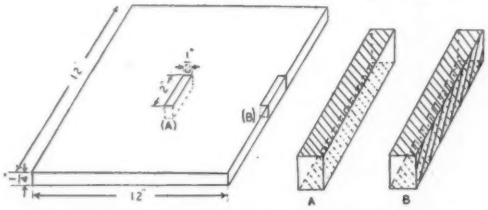

FIG. 13.—*Diagram illustrating the Effect of Position on the Cooling Surface of a Unit of Fixed Size. The Cross-hatched Areas indicate the Freely-cooling Surfaces.*

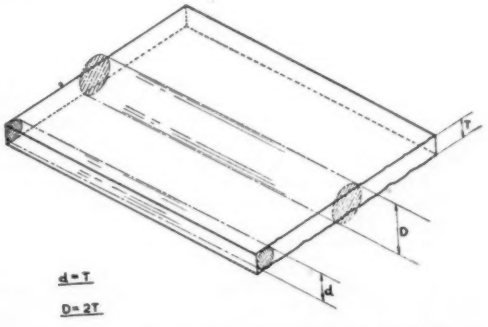

FIG. 14.—*Equivalent Diameter of the Centre and Edge of a Flat Plate.*

* Paper presented to the Buxton Conference of the Institute of British Foundrymen.

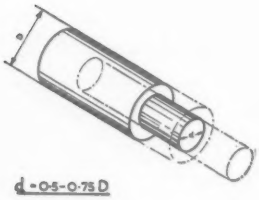

FIG. 15. — *Equivalent Cooling Diameter of the End of a Round Bar.*

of heat-exchange from metal at the solidification point to cold sand must be much more rapid than to sand which has been heated to approximately the temperature of the metal itself for an appreciable thickness. This is the simplest of the interferences with the cooling rate. Assumption (*d*) is also an approximation, since the skin of a casting solidifies more rapidly than the centre.

Effect of Adjacent Masses

The effect of adjacent portions of the casting is not readily predictable on a useful quantitative basis. Certain simple rules, however, can be adduced which can be usefully employed by the foundryman. In the structural diagrams (Fig. 7) the section thickness quoted assumes that the cooling rate is the same for bars and plates when the bar diameter is twice the thickness of the plate; *i.e.*, it is assumed that a bar 1 in. dia. cools at the same rate as a plate of ½ in. thickness. From a geometrical point of view, this ratio holds good for the middle of an infinitely long bar and the centre of an infinitely large plate of appropriate thickness. This 2:1 ratio for simple bars and plates holds reasonably well for structures in bars up to about 1.5 in. dia. and plates up to about ¾ in. thick, and the 1:1 ratio holds reasonably well for the free edges of simple plates, *i.e.*, the " equivalent diameter " of the edge of a plate is the same as its thickness for plates up to about ¾ in. thick (Fig. 15). It is unwise to assume these relationships for shapes of larger dimensions.

Strength at the Centre

In assessing the strength at the centre of castings, the curves shown in Fig. 4 may be used, on the assumption that the ratio of diameter to thickness between simple bars and plates for equal strength starts at about 2:1 for bars up to about 1.2 to 1.60 in. dia., and may range from 2.0:1 to 1.3;1 for the 2.1 in. bar. At 3 in. or above, the centre of a bar is likely to have about the same strength as the centre of a simple plate whose thickness is equal to the diameter of the bar. The falling-off in strength with sections thicker than the 2.1 in. bar is much slower than in thinner sections, particularly with high-strength irons; nevertheless, very wide individual differences have been recorded with irons of similar nominal grade, and the cross-hatched section of the curves in Fig. 4 extending beyond the 2.1 in. bar can be only regarded as a rough approximation, from which variations may well be wider than in the curves up to 2.1 in. Such approximation, however, can serve a very useful purpose in the absence of specific experience relating to a known iron.

Application of the Curves

In order to make use of these curves, it is necessary to assess the cooling rate of a casting or section of a casting, and it is futile to attempt an elaborate system of corrections or allowances. Probably the simplest and most practical method is to use a system of inscribed and circumscribed circles. Thus, the maximum diameter that can be inscribed in the section is obviously less than the smallest equivalent diameter to which the section can be related and is therefore likely to represent the very highest strength which can be expected in the section. The circumscribed circle, where it is applicable, is more likely to represent the equivalent diameter to which the portion of the casting can be related, and hence may be expected to represent more nearly the strength to be expected in the section. Adjacent portions of the castings will have an effect on the cooling rate, and increases of 25, 50 or even 100 per cent. on the strictly circumscribed circle may be required, and this can only be done by visual estimations and experience. The figures obtained, however, are likely to be reasonable approximations.

Internal cores, if smaller in cross-section than the wall thickness, can be assumed without much error to behave as solid metal. If the minimum cross-sectional dimension of the core is more than eight to twelve times the wall thickness of the casting, the special effect of the core can usually be ignored. As a very rough guide Table I may be used to assess the effect of cores.

Strength Relationship

Interpretation of the strength figures derived in the foregoing manner requires some caution. The tensile strengths derived are those likely to be found in the centre of the section and such figures will be appreciably lower than those found near the surface of the casting. This is recognized in the B.S.1452 in its relation between test-bars and section size, and at the same time constitutes one of the chief difficulties in the use of Dübi's method of relating tensile to hardness, since hardness figures must neces-

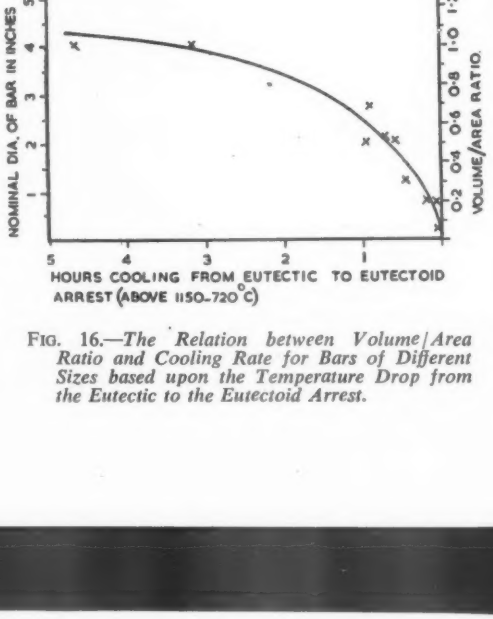

FIG. 16.—*The Relation between Volume/Area Ratio and Cooling Rate for Bars of Different Sizes based upon the Temperature Drop from the Eutectic to the Eutectoid Arrest.*

TABLE I.—*Minimum Core Dimensions Related to Wall Thickness.*

Minimum core dimension between metal walls.	Less than metal wall-thickness.	Equal to or twice metal wall-thickness.	2 or 4 times wall-thickness.	4 to 12 times wall-thickness.	12 or more times wall-thickness.
Correction to "equivalent diameter" of casting thickness	Core taken as solid metal	× 2	× 1.5	× 1.2 to 1.5	× 1.0

sarily be taken on the surface if non-destructive testing is intended. The error, however, is of less importance than might appear, since under many forms of stress to which castings are subjected, the weakest portion of the casting is in the neighbourhood of the neutral axis and the highest stress occurs at the skin, where the strength is highest. This therefore will provide an intrinsic factor of safety if the strength of the casting is calculated from the strengths derived from the foregoing curves.

Simple Examples

As an example of the way in which the foregoing curves can be used, a simple casting consisting of a plate 1¼ in. thick adjoining a section tapering from ½ to ¼ in., is specified to give 18 tons per sq. in. in the 1¼ in. section. It is shown in the Paper that the cooling rate of a 1¼ in. thick section is approximately the same as for a 2 in. dia. bar and from Fig. 4 it will be seen that an iron giving 18 tons per sq. in. in a 2 in. bar will give about 20 tons per sq. in. in a 1.2 in. bar. From Fig. 2 it will be observed that a carbon-equivalent value of about 3.6 will be required to give an iron of this strength and the specification would be likely to be met by an iron containing total carbon 3.0 per cent.; silicon 1.7 per cent.; phosphorus 0.1 per cent.; or an iron containing total carbon 3.2 per cent.; silicon 1.0 per cent.; phosphorus 0.2 per cent., or any other reasonable range of composition conforming to the carbon-equivalent value of 3.6. By reference, however, to Fig. 7 it will be noted that a carbon-equivalent value of 3.6 tends to run mottled on a bar diameter of 1.0 in. or a plate thickness of 0.5 in., and therefore the ¼ in. section of the casting would be expected to be hard and unmachinable if a tensile strength of 18 tons per sq. in. were obtained in the 1¼ in. section. Thus, in this case it is clear that the tensile specification has been set too high for the casting if made in an unalloyed, non-inoculated iron.

The maximum tensile strength which can be obtained in a 1¼ in. section if a ¼ in. section in the same casting is to be grey, can be obtained by reference, first, to Fig. 7 which shows that the minimum safe carbon-equivalent value for a ¼ in. section is 4.0 to 4.1. By reference to Fig. 2 it will be seen that this iron is likely to give a tensile of 14 to 16 tons per sq. in. on a 1.2 in. bar and on looking at Fig. 4 it is apparent that this iron would be expected to give a tensile of 11 to 13 tons per sq. in. in a 2 in. dia. bar or a 1¼ in.-thick section. The maximum strength, therefore, which can be expected in this casting in the 1¼ in. section, if the thinnest section is to remain grey, is 11 to 13 tons per sq. in.

If the ¼ in. section runs out to a free edge of the same thickness, then an even lower strength must be allowed for in the thicker section if the free edge is to remain free from chill. It should be pointed out that, in this summary, average strength figures have been used; cast iron specifications, however, usually call for minimum strengths and the carbon-equivalent values required will, therefore, be slightly lower than those indicated in the curves.

Acknowledgment

The Author's thanks are due to the director and Council of the British Cast Iron Research Association for permission to present this Paper.

DISCUSSION

MR. REYNOLDS said that he noticed Dr. Angus had not mentioned the question of runners. The practical man could often control the cooling of a casting, or help it by the method of running. If the runners were single and heavy, they tended to create a hot spot on the entrance of the runner. If distributed runners were used, a totally different set of cooling conditions was created; it was not always possible to go by diagrams—one had to have experience and knowledge.

Founders should not have many widely different mixtures and should try to arrange them (except for special irons) to near the eutectic point, or slightly below it. Sounder castings were ensured by this method. Phosphorus content should be limited to that necessary to give the required fluidity. Phosphorus was always deleterious, particularly when making castings of variable section. It was preferable to proceed from the rather harder and unmachinable side and then add a little silicon, or if it be preferred, silicon manganese; he had found he obtained a stronger and better structure by so doing. He had followed that system now for 20 years with great success.

DR. ANGUS agreed with Mr. Reynolds on the running method. He had cast recently a series of rather thin plates which showed up the runner effect quite clearly. The plates, which were approximately ½ in. in thickness and about 9 in. square, were flush-gated on one side only and were entirely grey on the runner side and entirely white on the side remote from the runner. That was one of the things in which the foundryman's experience had to play a part; it could not be learned from diagrams. He was in full agreement with working from the hard side and thought, if foundrymen did so, they could use fewer mixtures.

MR. H. FARMER said Dr. Angus would be pleased to know that his firm had checked up on all his statements and figures in their own laboratory. These were found to be true, and all the curves were true in their interpretation. He proposed that Dr. Angus should go still further in that type of work, so that foundrymen could understand all the variables.

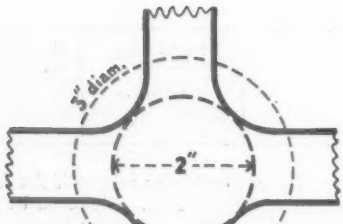

FIG. A.—*Section at the Junction of Four Webs of a Casting, showing the Application of Inscribed and Circumscribed Circles.*

Shock Resistance

DR. RILEY asked a question relating to shock resistance. The statement was that the resistance of iron to shock bore no relation to the carbon-equivalent value. While that might be approximately true, he felt that, if the silicon percentage was raised, then the iron was more susceptible to shock than it was with a lower silicon content. Perhaps the original statement needed a little qualifying.

DR. ANGUS said that he had worded the statement in that manner because the carbon-equivalent value, in the way he had calculated it, included phosphorus. He could get a 17-ton iron with 0.7 per cent. of phosphorus, but the shock resistance would be low. If low-phosphorus mixtures only were considered, then the shock resistance would increase, generally speaking, as the carbon equivalent was lowered.

MR. REYNOLDS agreed on the general conclusion that high silicon would make for shock resistance. He had had a fair amount of experience of making ingot moulds for casting copper. Before he started manufacture the technicians advised that he should use a close-grained iron. He used it and every mould cracked—some of them actually burst the first time any copper was cast in them. He then annealed them (using the same composition) but found eventually the only solution was a hematite type of iron with fairly high carbon and high silicon, much more than would be found in the iron indicated.

DR. ANGUS pointed out that they should have considered their terms a little more closely. They should have referred to mechanical shock. Thermal shock was something quite different. In general, the higher the graphite content the greater the resistance to thermal shock.

MR. HUGHES wanted to know if it was possible nowadays to alter the number of irons in use. On reading the Paper one would be inclined to continue with the largest number of mixes possible to suit the type of work being handled.

Fewer Mixtures

DR. ANGUS replied he did not think the Paper could be interpreted as recommending the use of more than one mixture. It merely gave an idea as to what any particular mixture would do. He personally always recommended as few mixtures as possible. He hoped the data given in the Paper would give the foundryman an idea of how far he could make his requirements conform to the properties of any particular mixture..

He did not advocate the use of a quantity of mixtures because in the cupola it was very difficult to be certain where special metal began and ended. The comments and the information in the Paper would, he hoped, help the foundryman to use fewer rather than more mixtures.

MR. GREAVES commended particularly those sections of the Paper which dealt with the effect of casting design; it was astounding to realize that in actual practice the tensile figure could vary from 9 to 16 tons per sq. in. in the same casting (strangely enough the low figure was obtained on a bar cut from a 1½-in. section, whereas the higher values were obtained on the heavier section). He thought the emphasis which Dr. Angus had laid on this point should be carefully noted by any foundryman attempting to work on the figures, and that some work should be done, in the future, in an attempt to understand and control the effect of adjacent bodies on the cooling from liquid to solid of irregular, and yet connected, masses of metal.

DR. ANGUS said they had tried to put forward a scheme which indicated the effect of adjacent sections, but of course any theoretical scheme put forward could be subjected to criticism. He had carefully stated that the scheme was an approximation, and it might have some value, but it had to be reinforced by experience.

Inoculated Irons

A MEMBER asked whether Dr. Angus had any evidence that some of the uncertainty in the curves illustrated was produced by the use of modified or heavily-inoculated irons?

DR. ANGUS said he did not think that the degree of uncertainty would be reduced; there were far too many variables in melting, moulding and pouring practice. As an approximation they could take the upper line of the band to represent inoculated irons, but inoculation was more effective in high-strength irons and it was not really possible to use such curves to estimate the likely effect of an inoculant—they would merely show the probable strength to be found with the non-inoculated base iron and the effect of inoculation would have to be based on experience with a particular grade and quantity of inoculant.

ANOTHER MEMBER said the greatest value of the Paper was that it dealt with a straight, non-inoculated cast iron. In past years he had been doing a great deal to the high-duty irons by inoculation, and had tended to forget that the whole basis of it was a straight iron as melted in the cupola. As

to the question of design and translating it to the drawing board, the last illustration presented some difficulty in translating the effect of the section to the design side.

Inscribed and Circumscribed Circles

DR. ANGUS thought interpretation could be made with some degree of certainty. Foundrymen could look at the drawing and, if they wished to avoid chill, and to have all parts of the casting machinable, they should look to the thinnest free edge, and put an inscribed circle on it. If they proposed to work with a metal mixture which would chill in a round bar of that diameter, then they were likely to get trouble. If they used a softer mixture or added an inoculant, trouble could be avoided. An examination of this type on the drawing board could therefore determine the hardest mixture that could be employed without producing chill; this would decide the likely strength to be found in the thickest sections, since the strength of iron that could be put into a casting was determined by the thinnest section that was required to be grey.

MR. REYNOLDS said that from personal experience he had found in using fairly common irons that he got a better and more consistent result by using two pig-irons as against one only. If they used pig-iron "A" or "B" alone, they achieved a given result, but if they used them in combination, they invariably had a better one, as well as a higher tensile strength with more consistency.

Written Comment

DR. ANGUS wrote that illustrations, Figs. A and B, may serve to illustrate the use of inscribed and circumscribed circles. Fig. A represents the junction of four webs, each 1 in. in thickness. The minimum section at the junction is 2 in. The 1-in. inscribed circle at the end of the lower web represents the smallest size of bar which would have a cooling rate approaching that of the section at this point. The 2-in. inscribed circle at the junction represented the smallest size of bar likely to be representative of this section. In view of the effect of the adjacent webs on the cooling rate, however, it would be safer to assume a cooling rate equivalent to a 3-in. dia. bar —as shown circumscribed. Thus, from Fig. 4 of the Paper, if a grade 17 iron were being used, a tensile of 16 to 18 tons per sq. in. would be expected at the end of the web, whereas in the centre of the junction the maximum strength likely to be found would be 14 to 15 tons per sq. in. based on the 2-in. bar, but more probably a tensile of 13 to 14 tons per sq. in. would be found, equivalent to a bar diameter of 3 in.

Fig. B shows a polished and etched light-section angle bar, approximately $\frac{1}{4}$ in. across the flats and in which the smallest inscribed circle is 0.15-in. dia. at one tip, 0.18-in. dia. at the thicker tip and 0.25-in. dia. at the junction. This casting was made in iron with the following percentage composition:—T.C, 3.08; Si, 2.55; Mn, 0.64; S, 0.056; P, 0.22; C.E. value, 4.0. From Fig. 7 it will be seen that some mottle would be expected in any bar less than 0.4- to 0.5-in. dia. with an iron of this C.E. value. This section,

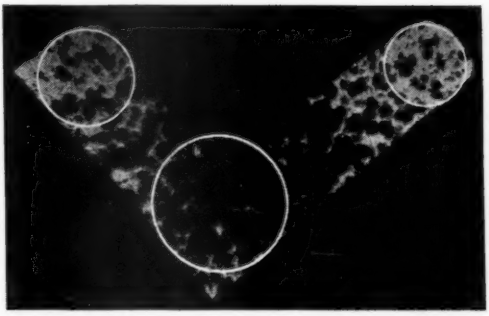

FIG. B.—*Section through a Cast-iron Angle Piece, Polished and Etched to show the Structures at Apex and Extremities.*

however, shows clearly that even in these small sections a re-entrant angle causes a hot spot and a projecting tip increases rate of cooling, both these effects being apparent in the 0.25-in. dia. circle at the junction of the two webs.

The CHAIRMAN (Mr. E. Longden), closing the discussion, said Dr. Angus had given them a Paper of the utmost importance and value to the foundryman; it gave him very much pleasure to propose a very hearty vote of thanks.

MR. GRESTY, seconding the vote, said he was glad indeed to second the chairman's proposition and add his tribute to the work that had been done.

DR. ANGUS, responding, said he would emphasize that the work had been done by associates as well as himself, and on the present occasion he had had the privilege of being asked to put it together in a more assimilable form.

High-Temperature Dilatometer

Among equipment recently acquired by the British Cast Iron Research Association is a high-temperature dilatometer (Harry W. Dietert Company, Detroit), for research into moulding sands. Briefly, the instrument will be employed to study the basic rheological properties of moulding materials at room and elevated temperatures, the latter being the most important. It is hoped that this apparatus will help to solve the problem generally known as "scabbing," which is caused by the penetration by the molten metal of the mould face. It is also hoped that the work will lead to improvements in the surface finish of castings. The results of this research are expected to increase productivity by reducing the amount of scrap and by enabling castings to be made to closer dimensional tolerances, thus reducing the amount of machining required.

THE US NATIONAL HARDWARE SHOW, at which last year representatives from 45 foreign countries attended, is to be held at the Grand Central Palace, New York, from October 6 to 10. Exhibits will include hand tools, electric-powered tools, builders' equipment, light industrial and agricultural equipment, and garden tools and equipment. The show was first held in 1946.

Nodular-graphite Iron

Effect of Additions Studied

Recent studies by Alexander I. Krynitsky and Harry Stern, of the U.S. National Bureau of Standards, increase the available information on the effects of different additives on the formation of nodular-graphite iron.

Additives investigated at the Bureau were magnesium, magnesite, iron-sulphide, calcium, nickel/chromium/molybdenum, and boron. Cerium was not included, because published information on its application as a nodulizing agent was relatively complete when the study was begun. Besides the different additives, the investigation included such variables as composition, melting and pouring temperatures, and cooling rate.

In the investigation, completely nodular graphite was obtained only in iron containing magnesium in excess of 0.03 per cent. Two types of nodules were observed, radial and structureless, the structureless type frequently having a crystalline core. Results with magnesite, magnesia, and other additives were essentially negative. However, oval or irregular patches of graphite, not true nodules, were observed in iron treated with magnesia, iron-sulphide, and boron. Only a few nodules were observed in calcium-treated specimens, but this was probably because of the rather small amount of calcium retained; other investigators have reported 100 per cent. nodular-graphite structures in irons having calcium contents higher than were obtained in this series.

The experimental method involved melting cast irons of various compositions in a high-frequency induction furnace. After the melt reached the desired temperature, the nodulizing agent under study was added. In general, the melt was next inoculated with 0.4 per cent. silicon and then cast into round bars. These were examined chemically, spectrochemically, photomicrographically, and for hardness.

Initial experiments with magnesium as the nodulizing agent used commercially pure magnesium. However, the violence of the reaction between pure magnesium and molten iron made close control of these early melts difficult. This method of addition was therefore abandoned, and the magnesium was supplied in the form of an alloy containing 80 per cent. Cu and 20 per cent. Mg.

Effect of Cooling Rate

The effect of cooling rate on microstructure was determined by casting wedge-shaped bars. The cooling rate, greatest near the apex of the wedge, was observed at intervals along the bar by means of thermocouples (Fig. 1). Rapid cooling favoured nodule formation, but the effect of the cooling rate decreased with increase in magnesium content. No relation between nodule formation and pouring temperature or maximum heating temperature was observed. Results of the investigation support the belief that nodular graphite is formed in the melt during solidification, and that patches of graphite are produced by decomposition of carbides.

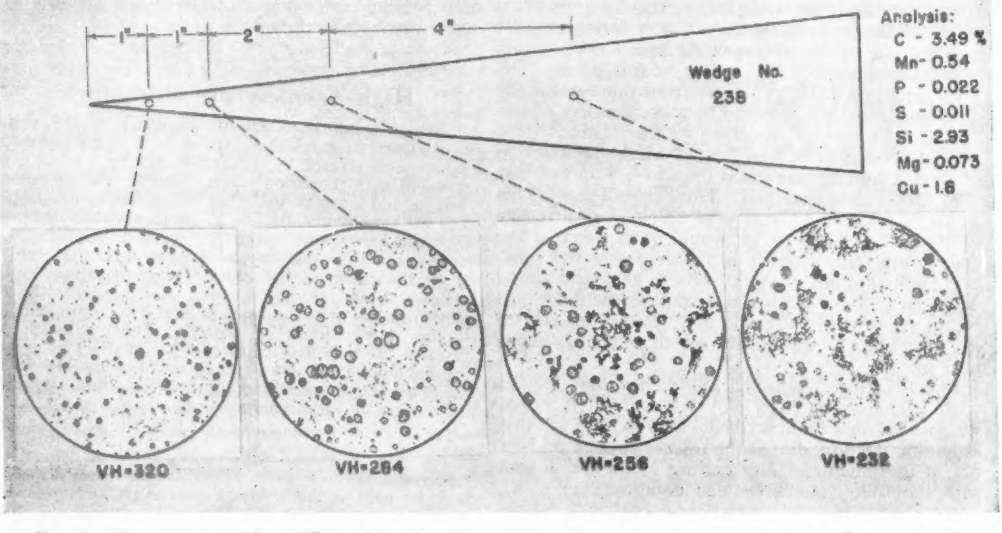

FIG. 1.—*Experiment to Show Effect of Cooling Rate on the Microstructure of Modified Cast Iron. The Slower-cooling Regions (right) Show a Flakier and Less-nodular Graphite Structure.* × 100.

VH = Vickers hardness number using 10 kg. load.

Process Control in Vitreous Enamelling*

By H. W. Clewes

For the economic production of vitreous-enamelled cast-iron and sheet-iron components to a high-quality standard, the variables in the processing procedure must be kept as constant as possible. The variables which it is necessary to control to obtain the best results, can be kept at a minimum primarily by:—(a) *mechanization;* (b) *minimum number of finishes and colours;* (c) *long runs in production of one component; and* (d) *control of processing. It is the purpose of this Paper to outline a method of control developed from experience and application over a number of years. While the methods used may vary to some degree with the particular manufacturing unit, it is felt that the principle in general could be applied to any mass-production vitreous-enamelling process.*

The main items to which control should be applied are:—

(1) *Base Metal and its Preparation;* (*a*) pickling (sheet iron) and (*b*) shotblasting (cast iron).

(2) *Enamel Slurry;* (*a*) examination of materials, (*b*) milling operation and (*c*) slurry control.

(3) *Application of Enamel* by (*a*) swilling and (*b*) spraying.

(4) *Drying.*

(5) *Firing.*

(6) *Examination of Finished Ware;* (*a*) visual, (*b*) acid-resistance tests, (*c*) heat-resistance tests and (*d*) thickness.

General Specification

An overall general specification giving details of the processing should be formulated. This is usually carried out in conjunction with the frit manufacturer. A copy of this specification and subsequent alterations should be issued to all concerned in the enamelling process. Such a specification is illustrated in Table I.

The basis of all process control is to lay down a standard procedure and to maintain practice to the standards laid down.

Sheet Iron

Very little variation in the base metal occurs if enamelling-quality sheet iron is obtained from a reputable supplier. Unfortunately, owing to material shortages at the present time, inferior grades of sheet metal have found their way into the vitreous-enamelling industry and "fish-scaling" and other defects may occur. The only check on this quality of the metal is to carry out standard-practice enamelling trials on sample sheets of the whole batch. After standing for a few days any tendency to "fish-scale" will become apparent.

Pickling

Conditions in the pickling process should be such that ware is obtained from the plant which has been completely degreased and evenly etched by the acid. The ware should be free from scale and rust, any residue of acid completely neutralized to give a component which will not show defective in the following process. Standard operating conditions should be laid down, those in Table II being typical of current practice.

A combination of the vapourizing trichlorethylene type of degreaser followed by the alkali cleaner is usually necessary to deal effectively with the grease and drawing compounds encountered in normal production. With some types of alkali degreaser, over-heating causes the wetting-agent to break down. This will render the solution as a whole less effective and the wetting agent also adheres to the ware when the baskets are withdrawn. Too low a temperature or strength will also render the alkali degreaser solution less effective. If the degreasing is not carried out thoroughly, the acid cannot attack

* Paper presented at the spring meeting of the Institute of Vitreous Enamellers at Southport.

TABLE I.—*Typical General Specification for Processing Enamelled Ware*

Material Spec. No.	Description of Part *1,430 OUTSIDE SIDES* Finish *Cream.*	Serial No. No. of Sheets
CAST IRON	SHEET IRON	
Weight (lb.) ..... Overall size	Area (sq. ft.) *4.167* Blank size	Overall size *18½ in. by 33 in.* Cut from sheets (size)..... Supplier *Leeds.* No. of blanks per sheet .....

Op. No.	Dept.	Description of operation.	Frit code No.	Colour.	Chain speed.	Fuse temp.	Fuse time-cycle.	Piecework rates.
1	*Pickling*	*Pickle.*						
2.	*Enamelling*	*Swill in ground-coat.*	*SG1, 2 & 6*	*Gd.-coat.*				
3.	*ditto*	*Fuse* ,, ,, ,,			*7½ ft. per min.*	*845 deg. C.*	*4½ min.*	
4.	*ditto*	*Spray 1st coat in cream.*	*ASW9*	*Cream*				
5.	*ditto*	*Brush ½-in. deep from return edge.*						
6.	*ditto*	*Fuse 1st coat cream.*			*7½ ft. per min.*	*820 deg. C.*	*4½ min.*	
		Re-coat.						
..	*Enamelling*	*Spray 2nd coat in cream.*	*ASW9*	*Cream*				
		Brush ,, ,, ,, ,,						
		Fuse ,, ,, ,, ,,			*7½ ft. per min.*	*820 deg. C.*	*4½ min.*	

Date issued.....

TABLE II.—*Typical Standard Operation in Pickling Procedure.*

Degreaser	I.C.I. A.D.A. No. 1 cleaner. Strength—8 oz. per gall. Working temperature—200 deg. F.
Rinse	Running water. Temperature—over 130 deg. F.
Pickle acid	Sulphuric acid. Strength—7 per cent. solution (by weight). Working temperature—150 deg. F.
Rinse	Running water. Temperature—over 130 deg. F.
Nickel dip	Nickel sulphate and boric acid. Strength—nickel sulphate (crystals) 1.25 oz. per gall. boric acid 0.32 oz. per gall. Working temperature—150 to 155 deg. F. Limits of *p*H—4.5 to 5.5.
Rinse	Running water. Temperature—over 130 deg. F.
Neutralizer	Hydrated borax and soda ash. Strength—borax 22.5 oz. per gall. soda 4.5 oz. per gall. Working temperature—180 deg. F.

the surface of the iron, with the result that the ware will be only partially or unevenly pickled. In the swilling of the ground-coat, the slurry is unable to wet the surface where grease still adheres. When the acid temperature and strength are not kept correct the sheet iron may be over- or under-pickled. In the former case, trouble may be experienced in the subsequent enamelling process due to "boil" defects, etc. In the latter case the ware will have to be re-pickled, causing delay and higher costs.

Adequate neutralizing is necessary since localized areas of acid sometimes found on the ware will "set up" the ground-coat slurry and cause uneven swilling. This same uneven swilling can be caused by excess borax from the neutralizer, which will also "set up" the ground-coat slurry.

The difficulties which may result from bad pickling practice are sufficient to suggest that once good pickling conditions are established, they should be rigidly maintained. In order to maintain a constant timing factor, a fully-mechanized automatic plant is sometimes used, with the temperature of each solution thermostatically controlled. The laboratory should be in total control of the "making-up" of the solution and the maintenance at correct strength, temperature and condition. With the automatic type of plant, due to the greater through-put of ware, the deterioration of solutions as regards strength and contamination is increased, necessitating more frequent checking, particularly of the still wash-waters which quickly become polluted. Often overlooked is the procedure which should be laid down for the loading of the ware into the baskets to give adequate room for the solutions to percolate freely to all surfaces and to allow the free draining of all solutions from the ware. The iron content of the acid solutions should not be allowed to exceed a fixed maximum for the type of acid in use. For example, conditions in Table II suggest that the iron content should not exceed 6 per cent. Serious boiling on super-opaque enamels was experienced when this figure was allowed to rise to 6.9 per cent.

Of late years, advantages have been obtained from imparting to the pickled ware a thin coating of nickel. This is incorporated in the normal pickle sequence and gives better adherence of the ground-coat and acts as a safety measure against "copper-heading." It is most necessary to have adequate filtering of the nickel-dip solution, as iron compounds are constantly being formed in replacement of the nickel taken from the solution. To control the thickness of the deposit, it is essential to control the strength, temperature, and *p*H of the solution. Too heavy a layer of nickel will cause severe "boil" in the subsequent enamel coatings.

It has been found to be of definite advantage to use softened water for the "making-up" of the degreaser, neutralizer, nickel dip and degreaser rinse tanks. This avoids the hardness salts being deposited on the pickled ware, which at times may give "copper-heading" and an uneven surface to the fired ground-coat.

Shot-blasting of Cast Iron

The methods and type of plant used for shot-blasting vary considerably. Table III gives the types of chilled-iron grit in use at present. For the purpose of control, useful information can be obtained by expressing as a percentage the weight of grit which will stay on a 20-mesh British Standard sieve and the amount which will go through a 60-mesh B.S. screen. A maximum of 20 per cent. fines for the flat conveyor belt Wheelabrator and 7 per cent. fines for the box-type of shot-blasting plant should prove satisfactory.

TABLE III.—*Chilled-iron Grit Available for Shot-blasting.*

Type of machine.	Shot added in 24 hrs.	Type of shot.	Extraction.	
			Fines.	Dust.
Flat conveyor belt Wheelabrator	16 cwt.	10	12	30
Round barrel Wheelabrator ..	2 cwt. per week	16	3	6
Box cabinet	3 cwt.	16		

Testing of Mill Materials

Frit

During recent years, great emphasis has been placed on improved quality of enamelled finish and this has meant a more critical approach to colour control. All frits vary to some extent, in the Author's experience, and where accurate matching of colours is essential, it has been found that considerable time can be absorbed by adjusting mills of enamel; thus a better approach is to test the frit on a batch basis so that necessary adjustments can be made prior to the production milling. All examination for colour is carried out under standard lighting conditions. The samples are prepared for examination by milling and firing the frit under standardized conditions.

Oxides

These are tested by milling a representative sample from each consignment with the frit with which it is to be used in production and checked for colour and finish to the standard. A re-firing check should also be carried out to confirm colour stability. This is most important. This test is preferred to the usual "firing-range" test, since it is felt that the re-fire is more representative of conditions encountered in production. Firing in a laboratory muffle does not give a satisfactory comparison with production con-

ditions. The " fired " trial sample is also examined for gloss and scumming; the latter particularly in the case of black oxides.

Clays

The enameller requires a ball-clay which is finely pulverized, free of foreign matter and which does not seriously affect the colour of the fired enamel. The clay particles should easily disperse throughout the mass of slurry to give a good suspension. The clay should give the biscuit enamel a strength satisfactory for handling, coupled with good brushing qualities.

Clays and bentonite are usually milled with a standard frit and examined for finish and colour. A quantity washed through a 200-mesh sieve will show any coarse-ground material and foreign matter. A tentative specification has been drawn up for routine use. This, however, is still in the trial stages and is subject to modification in the light of experience. It is intended eventually to test each consignment of clay prior to use on a more comprehensive basis.

Quartz

Quartz for use as a mill addition is tested for fineness of grinding (through a 200-mesh B.S. sieve), and any residue examined for foreign matter, particularly metallic iron.

Milling

The object in the mill-room should be to prepare consistent slurries for the use of the enamel shop. In order to achieve this, routine checks should be made on all water-measuring or weighing equipment. This elementary point is often overlooked. It is important that every effort should be made to maintain operating conditions as constant as possible. Absolute cleanliness and adequate covered storage accommodation for all materials are essential. The milling time and number of revolutions made by the mill should be kept constant. This is helped by individually-driven mills with constant loading. Altering the loading of the mill may produce overheating, with an over- or under-set condition of the slurry. At regular intervals, every mill should be emptied so that the mill lining and pebbles can be inspected and the pebbles made up to the necessary weight. In order that the daily operation of the mills can be compared with standard procedure, the history of each mill should be noted in a log book (Table IV). For each charge put through, a mill control-card should be made out at the time of charging, and not at the end of the day as was often the case (Fig. 1). A list of standard milling formulæ for each enamel should be available for the use of the mill-room foreman. He should only deviate from these standards on written authorization.

When the milling of a charge is almost completed, a sample is taken for a sieve test. This should be carried out as follows: 50 ml. of the slurry is washed through a 150- or 200-mesh B.S. sieve and the residue dried at 200 deg. F. and weighed. Care should be taken to keep the same force of water-jet and drying temperature. When the slurry is down to the standard fineness, a " fired " trial should be made under production conditions on a production component. This trial should then be examined for finish, colour match to standard and acid resistance where required. The " fired " trial sample is kept on file until the enamel it represents has been used in production. Where the colour is not satisfactory, adjustments should be made to the mill. Additions of oxides or opacifiers should be ground with a quantity of the main body of slurry, in a small jar mill, prior to the introduction into the large mill.

TABLE IV.—*Examples from the Log Books of No. 6 Mill and No. 14 Mill.*

Date.	Card No.	Type of slurry.	Quantity of frit (lb.).	Total milling time (hr.).	Final fineness, gm.
22/2	3,728	Jet black	300	6	14
25/2	43	" "	300	7¾	14
26/2	73	" "	300	6	14
26/2	85	" "	300	6	14
27/2	95	" "	300	7	14
27/2	3,806	" "	300	6½	14
28/2	17	" "	300	6½	14
28/2	23	" "	300	7¼	12
29/2	28	" "	300	7	13
29/2	38	" "	300	6½	13
29/2	4,445	" "	300	6	12
3/3	50	" "	300	7¼	13
4/3	58	" "	300	6½	13
5/3	64	" "	300	6½	14

No. 14 Mill.

Date.	Card No.	Type of slurry.	Quantity of frit (lb.).	Total milling time (hr.).	Final fineness, gm.
22/2	3,727	S.P. ground coat	2,500	25	7¼
25/2	51	" "	2,500	23	7
26/2	80	" "	2,500	23	8
28/2	3,819	" "	2,500	23	7
29/2	33	" "	2,500	23	7
3/3	55	" "	2,500	23	8
4/3	78	" "	2,500	24	8
6/3	3,911	" "	2,500	23	7

Recovery of Returns

The essence of successfully re-using returns from the spray booth or swilling bosh lies in keeping them free of contamination. Any arrangements

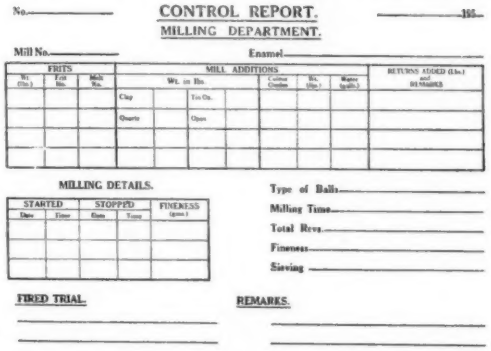

FIG. 1.—*Example of a Mill Control Card which should be Completed at the Time of Operation.*

FIG. 2.—*Consistometer for estimating the Flow Characteristics of a Slurry.*

which assist the sprayer or swiller in reaching this objective are to be highly commended.

With dry booth-scrapings it is necessary to re-mill for a short time to bring them back into a good slurry condition. In the case of returns with a high water-content, all that may be necessary is to mix them thoroughly. In each case, the specific gravity is adjusted to normal for that slurry. After a "fired" trial has been approved, the returns may then be added to freshly-milled slurry in proportions up to 50 per cent.

Because finer particles of slurry, including clay, are sometimes lost in the spray-booth exhaust system, the results from some returns slurry may be improved by the addition of up to one per cent. clay and/or one oz. per 100 lb. of electrolyte. Colour adjustment may be necessary on the returns slurry as the booth returns may contain a quantity of mottle from the spraying of splatter type finishes, where the mottling is done on the same spray booth as the base coat. The common practice of adding untested returns to the new batch just prior to the completion of milling, is not satisfactory, since good material can be easily spoilt by the addition of contaminated returns. The returns and the new batch should be tested individually before mixing.

The need for returns to be free of contamination is even greater in these days of the general use of one-coat finishes, since formerly the returns slurry could be used for first-coat application only. The subsequent saving in cost from the successful use of returns merits the concentration of those in supervision to obtain the necessary degree of cleanliness at all stages.

Slurry Control

The slurry is discharged through a 30- and 60-mesh screen (for cast and sheet iron respectively) into a receptacle bearing an identification mark. This is to identify the slurry in case of trouble in the enamel shop. The specific gravity of sheet-iron super-opaque enamels must be controlled more closely than in the case of cast-iron slurries, which are used with a much larger spray-gun nozzle, *e.g.*, sheet iron 1.72 to 1.74 s.g., cast iron 1.84 to 1.89 s.g. Without adequate slurry control, difficulties occur in the swilling or spraying, such as the familiar "orange-peel" defect caused by a high concentration of electrolyte with a high-specific-gravity slurry. The reverse case of a highly-set slurry with a low specific gravity will cause indentations in the sprayed slurry. Both instances are caused by the slurry incorrectly atomizing.

The effect of ageing on the slurry must be taken into consideration since an enamel slurry is not in a state of chemical equilibrium. Due to standing, further materials dissolve out of the frit, affecting the "set" of the enamel, which may increase or diminish with ageing. Some slurries, although satisfactory when first milled, on ageing cause in the finished enamel ware defects such as "parting," etc. Every endeavour should be made to keep a constant flow of slurry from the completion of milling to the swiller and sprayer so that each delivery of slurry will have aged by approximately the same degree. There are in general use many types of instruments for the purpose of slurry control. These are mainly of the flow-test type, two of which will be considered here.

The consistometer, Fig. 2, comprises a glass tube 53.0 cm. in length; 1.6 cm. bore; graduated in units of 10 ml. from 0 to 60. By means of a rubber bung, a stainless-steel capillary tube, length 12 cm. and bore 0.25 cm., is fitted into the lower end of the glass tube so that its upper end is level with the mark "C." The 60-ml. mark is 10.5 cm. above this mark.

To carry out the test the instrument is rinsed with water followed by a good swilling out with the enamel under test. The glass tube is filled with the enamel to within about one inch of the top and supported in a vertical position. The cap is removed from the capillary and the time noted for the slurry to flow from the zero mark to the 60-ml. graduation. To facilitate observation of the level of the slurry as it moves down the glass tube a few drops of water are added to the surface of the enamel immediately prior to the removal of the cap from the bottom of the capillary. For routine purposes it is sufficient to compare the flow time in seconds from 0 to 60 ml. with standards laid down.

The mobility and yield point of a slurry may be determined by noting the time taken for each successive 10 ml. from 0 to 60. A graph is plotted between the rate of discharge in ml. per second and the average column height (Fig. 3). The value where the linear graph obtained intersects the horizontal axis is termed the yield value and is a measure of the degree of "set" in the slurry. The slope of the line indicates the mobility. The steeper the slope of the line the more mobile is the slurry.

In the "slump" test (Irwin), the principal part of the apparatus is a cylindrical-shaped cup open at both ends, which rests centrally on a carefully levelled horizontal circular disc. The disc is graduated from the centre in circles from 2 in. dia. by 1 in. increments to 9 in. dia. The cup is filled with slurry to the graduation mark on the inside. Immediately the cup is lifted clear of the disc, the slurry flows to form a circle of x diameter slump. The cup is lifted by hand or, in the case of the less portable type of appliance, by mechanical means. The slump diameter and the specific gravity of the enamel can be used to control all enamel slurries. While the slump tester is less accurate than the consistometer, the latter can be much slower in testing such high specific gravity slurries as some cast-iron enamels. Results from both appliances are empirical; the tests should be carried out with the same technique at all times. The

accuracy of each instrument can be greatly affected by vibration, such as might occur in any mill-room.

Application of Enamels

Swilling

The consistency of the ground-coat slurry in the swilling bosh should be closely controlled by means of the "dip-weight test." This is necessary apart from any testing of the slurry which may have been made in the mill-room. It is considered desirable to carry out dip-weight tests every hour to account for the evaporation of water from the slurry and the general practice in most works of adding drainings to the ground-coat bosh. At all times, the fresh ground-coat slurry or drainings should be charged into the bosh through a 40-mesh screen, followed by a magnetic separator. The drainings tend to get contaminated with swarf and iron filings from the pressings.

The dip-weight test is carried out in the following manner. A flat sheet of iron in the *freshly* pickled state, of known area, is immersed in the ground-coat slurry and then allowed to drain fully in the *vertical* position. The dip weight is calculated as the weight of dried biscuit enamel per square foot of surface area. The ultimate fired thickness bears a direct relationship to the dip weight, providing the swiller is constant in his method of operation.

With the low temperatures encountered in winter, the borax may crystallize out of solution. To obviate this, a battery of small open-jet burners may be placed under the swilling bosh tank to keep the temperature of the ground-coat slurry about 10 deg. C. During the colder months of the year, it is also general practice to add 1 oz. of hydrated borax per 100 lb. of ground-coat slurry to promote better suspension. The testing for thickness, by a magnetic-type gauge, of each swiller's dipped work, in the dried biscuit stage, is helpful towards keeping a constant ground-coat thickness.

Spraying

Factors influencing good and constant spraying, such as air pressure and wear on the spray-gun nozzle and needle, should be checked on a routine basis. Air pressures used vary with the slurry, type of spray-gun and component being sprayed. The super-opaque one-coat type of sheet-iron enamels with a range of specific gravity 1.72 to 1.74 are sprayed with a 1.5-mm. aperture nozzle and air pressure of 45 to 50 lb. per sq. in. with gravity-feed guns. Cast-iron enamel slurries are usually sprayed through a much larger nozzle with an air pressure of 50 to 65 lb. per sq. in. If the air pressure and nozzle aperture are not kept constant, the slurry will not be correctly atomized, producing a mottled and "orange-peel" surface. The delivery of the gun will vary and likewise the spraying technique. Spray guns can be tested for rate of delivery with a standard slurry and air pressure. This will show any deterioration of the nozzle and needle.

Drying

The use of open flat stoves and drying rooms is not to be recommended since these methods are inefficient. The continuous type of dryer is superior; with it, more constant control of the drying operation can be maintained. In the drying operation it is desirable to control the time, temperature and humidity of the dryer atmosphere. With the modern mechanized dryer, a set of fixed conditions should be laid down; a typical schedule being illustrated in Table V. With great changes in the humidity of the air supply to the dryer, the vents and temperature may have to be manipulated. With constant drying conditions, the hardness of the biscuit is more uniform, which is particularly desirable to obtain good "brushing" on one-coat work.

TABLE V.—*Typical Operational Schedules for a Mechanized Dryer.*

Cover-Coat Dryer.	
General Conditions.	
Temperature	300 to 350 deg. F.
Speed of conveyor	7½ ft. per min.
Period in dryer	10 min.
Venting Positions.	
Air-inlet vent	Fully open.
Exhaust vents (3)	Fully open.
Intake from continuous furnace	Fully open.
Burners.	
Two on full with	One temperature controlled.
Air on full	One not temperature controlled.
Exhaust fan on.	
Ground-Coat Dryer.	
General Conditions.	
Temperature	290 to 320 deg. F. (according to loading).
Speed of conveyor	16 ft. per min.
Period in dryer	6 min.
Venting Positions.	
Air-inlet vent	Fully open.
Exhaust vents (2)	Half open.
Hot-air return vents	Fully open.
Burners.	
Two on full	Two temperature controlled.
One on halfway	Not temperature controlled.
Air on full.	
Exhaust fan On	

The essentials in the satisfactory drying of the enamel slurry coating are that the moisture must diffuse to the surface and must evaporate as it reaches the surface. If the evaporation takes place faster than the diffusion of the moisture, due to the surface drying first, the biscuit enamel cracks, which causes "parting" in the firing operation. Fast drying may (especially in cast-iron processing) cause large pieces of the biscuit to fly off when the ware enters the fusing furnace. This is due to the retention of moisture under a hard-baked surface crust.

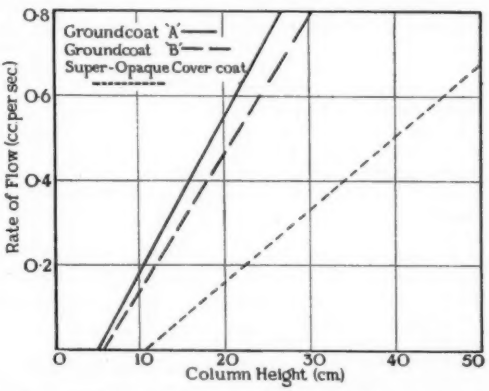

FIG. 3.—*Graph of Rate of Discharge against Average Column Height for Enamel Slurries Tested with the Consistometer.*

Process Control in Vitreous Enamelling

Fusing

Instructions on firing should give the time cycle as well as the temperature at which the load is to be withdrawn. A recording instrument working in conjunction with the furnace pyrometer will give a check on the operation of the furnace. Operating conditions are laid down to give a regular time cycle and to keep the muffle atmosphere at all times free of contamination from the products of combustion by maintaining a slightly negative pressure in the muffle flues. With a "U"-type continuous furnace the check for draught is made on the stack flue. The conditions laid down for a box muffle will include:—(*a*) The gas rate; (*b*) damper setting on the stack, and (*c*) air-inlet setting.

These settings will have to be varied according to the temperature and time-cycle required, with consideration to the loading, atmospheric conditions and gas pressure. Periodically, gas analysis will have to be carried out on the muffle atmosphere and the flue gases to indicate the state of combustion of the fuel and any leakage of flue gases into the muffle. Necessary repairs may have to be made to the muffle lining and, with box furnaces, the balancing of the distribution of heat may be necessary to keep an even temperature throughout the muffle. The furnace pyrometer should be standardized to a master instrument every day in the case of box muffles, and with continuous furnaces every week. Incorrect firing conditions may give innumerable defects, such as lack of gloss or acid-resistance, boiling, scumming and colour variation, etc.

Examination of Ware

The control chemist should make frequent visits to the intermediate and finished process stages to examine the ware:—(*a*) Visually for signs of defects; (*b*) to make thickness tests, and (*c*) to take samples for acid-resistance and heat tests, where required.

Samples should be taken on a routine basis, for comparison with standard colours. There should be liaison between the final inspectors and the process control so that the reasons for rejection can be assessed and investigated. Investigation into causes of rejection should be carried out in a systematic manner by the senior control staff. Random guesses are seldom successful and usually only waste valuable time, although, of course, experience will often indicate the factors which are most likely to be responsible. Tests are designed to eliminate, in turn, possible causes until the one responsible is isolated. Action can then follow to remedy the responsible factors.

In process control, a most essential factor to be recognized is that routine control staff should not be diverted to special investigation work, or else fresh difficulties will occur.

Thickness Tests

The maximum thickness of the enamel coating is laid down, particularly for heat-resisting components. As a general principle, however, on all production ware, thickness limits should be maintained to make the enamel less prone to the hazard of "chipping" or "flaking off." Different thicknesses of enamel also cause colour variation.

Acid-resistance

For the standard method of testing acid-resistance, the following reagents are to be employed:—(1) 2 per cent. sulphuric acid, and (2) 20 per cent. citric acid.

Duration of Test.—In each case, the reagent is to be applied to the enamel surface by cementing a short piece of 1-cm. dia. glass tubing to the test-piece and then filling the tube with the test reagent. The tube may be cemented using plasticine or similar material. The reagent is allowed to remain in contact with the enamel surface for a period of one hour, and the test is conducted at room temperature.

Method of Test.—When the reagent has been in contact with the enamel surface for one hour, the plasticine is removed and the enamel surface washed thoroughly with cold water and dried. A piece of filter-paper, previously dipped in a 10 per cent. solution of lead acetate, is then placed on the enamel surface and pressed down by means of a rubber bung used a a stamp. After one minute the lead-acetate paper is removed and the enamel surface is washed in running water for several seconds and then dried thoroughly with a clean towel. A filter paper is moistened with a 10 per cent. solution of acetic acid and is then placed on the enamel surface. This is covered by a piece of dry filter-paper and then pressed firmly with the hand on the enamel surface. After holding the paper in position for at least half-a-minute, it is removed and one or two drops of a 5-per-cent. solution of potassium iodide are applied. A yellow stain of lead iodide forms almost immediately if the enamel surface has been attacked by the test reagent. If no stain is apparent within ten seconds of applying the potassium-iodide solution, then the test has given a negative result and the enamel is satisfactory for acid-resistance with respect to the particular test reagent. The sample is considered satisfactory for acid resistance if a negative result is obtained with 20 per cent. citric-acid solution.

Heat-resistance

In the standard method for testing heat-resistance, the component for test is placed under a standard griller (No. 10- or No. 14-size frets) with the grill operating at normal rating at 25/10-in. pressure. The enamel surface should be 2½ to 3 in. from the underside of the grill frets. The component is allowed to reach a steady surface temperature of 350 deg. C. and is then removed and quenched by running a stream of cold water on the upper surface. The stream of cold water is directed to the centre of the heated portion and is continued until the plate is cold. The plate is then wiped dry and replaced under the grill. After heating again for a period of five minutes, the quenching procedure is repeated. The heating and quenching cycle is repeated 10 times, or until failure of the enamel by

(*Continued on page* 281, *at the foot of column two*)

Personal

MR. ARNOLD W. WOOD has been appointed foundry manager of Coneygre Foundry, Limited, Tipton, Staffs.

MR. D. N. GIFFORD, M.B.E., has been appointed a director of EFCO Engineering Company, Limited, of Burton-on-Trent.

STILL WORKING at the brassfoundry of W. H. Empsall, Stanhope Works, Henry Street, Bradford, is Mr. Elijah Clay, who celebrated his 80th birthday last Friday. He started with the firm as a boy of 15.

DR. TOM HEAP, who has been appointed principal of Derby Technical College, took up his duties on September 1. He was formerly principal of Luton and South Bedfordshire College of Further Education.

MR. J. M. DOUGLAS, formerly assistant foundries manager with Glenfield & Kennedy, Limited, Kilmarnock, has been appointed general manager of the Argus Foundry, Limited, Thornliebank, Glasgow.

MR. ROBERT ALLAN, brassfinisher, and MR. JAMES B. BROWN, iron turner, received the long service medal of Glenfield & Kennedy, Limited, from Mr. Henry Gardner, joint managing director, on their completion of 50 years' continuous service at the Kilmarnock works.

MR. J. W. BUTLER, secretary, Council of Ironfoundry Associations, has been appointed liaison officer of the United Kingdom delegation to the European foundry seminar which is being organized by the Machinery Committee of O.E.E.C. and is to be held in Paris, November 5 to 8.

DR. G. P. CONTRACTOR, in addition to his acting directorship in the National Metallurgical Laboratory, has been appointed by the Government of India as ex-officio director of inspection (metallurgy), Tatanagar, in the Directorate General of Supplies and Disposals, Ministry of Works, Housing and Supply.

MR. WILLIAM G. PEARSON, welfare supervisor of Swan, Hunter & Wigham Richardson, Limited, shipbuilders, of Wallsend (Northumberland), is to retire and will be succeeded by MR. D. LEETE. Mr. Pearson was Member of Parliament for Jarrow from 1931 to 1935 and was Mayor of Jarrow on three occasions.

MR. T. STACEY, sales manager of P. G. Allday (Birmingham), Limited, brassfounders, was presented on August 28 with a cheque and a clock by Mr. R. P. Allday, joint managing director, to mark the completion of his 50 years' service with the firm. The presentations were the gift of the directors, and colleagues made a further presentation. Mr. Stacey joined the company as an assistant despatch clerk.

LORD DUDLEY GORDON, aged 69, chairman of Hadfields, Limited, steelmakers and engineers, of Sheffield, had the misfortune to fall while going round the works last Friday, and was taken to Sheffield Royal Infirmary, where he was reported to be conscious and doing "as well as can be expected." He joined J. & E. Hall, Limited, in 1907, and rose to be a director in three years, managing director two years later, and finally chairman in 1937.

MR. LAURENCE C. BAXTER, chairman of the Birmingham branch of the Institution of Works Managers, is to take the chair at the national conference of the Institution in Birmingham in October, an occasion which coincides with the 21st anniversary of the Institution. Mr. Baxter is a 41-yr.-old Canadian, born at Alberta, who worked in the Argentine before coming to this country in 1934. During the war he was chairman of the Light Alloy Rivet Manufacturers' Association and a member of the Ministry of Production Productivity Council. He has an exceptionally wide knowledge of industrial conditions overseas, having visited factories in America, Sweden, Norway, Switzerland, Spain, France and Denmark.

House Organs

Malleable Iron Facts. No. 43. Published by the Malleable Ironfounders' Society, Union Commerce Building, Cleveland 14, Ohio, U.S.A.

Following the system established by this American organization, examples are given of where malleable castings (this time as shell adapters) have replaced bar stock with savings of metal, machine-tool time, man/hours and dollars; of meeting great complexity in design (rangefinders) and inherent toughness (mortar foot castings). To do this, but four pages are used—but they are used very intelligently.

600 Magazine. Vol. 26, No. 119. Published by George Cohen Sons & Company, Limited, Cunard Works, Chase Road, London, N.W.10.

The issue announces a newcomer to the 600 group. It is called Western Metallurgical Industries, Limited, and is to engage on the interesting and worthwhile job of extracting from an unsightly dump carrying 1¼ million tons of residue, 500 tons of iron, zinc and lead. The work is being carried on at the Branfort Works, Morriston, South Wales. Much modern plant is being installed. This issue also contains a full-length description of the works of K. & L. Steelfounders & Engineers, Limited.

Journal of Research and Development, Vol. 4, No. 7. August. Published by the British Cast Iron Research Association.

This issue contains four reports:—A Note on the Graphitization of Martensite, by J. W. Grant; The Determination of some Residual Elements which Produce Harmful Effects on Magnesium-treated Nodular Cast Iron, by W. Westwood and R. Presser; The Application of the Combustion Sulphur Method to Cast Iron, and the Prevention of Pitting Attack on Cast-iron Marine Propellers by Cathodic Protection. It is the last one which is most intriguing as by the fitting of a magnesium cap to the propeller, the attack is transferred to that component leaving the blades in good condition.

Process Control in Vitreous Enamelling

(*Continued from page* 280)

"flaking off" occurs. Heat resistance is satisfactory if no enamel is removed after 10 treatments. This test may be used for crown trays and interior cooker components.

Conclusion

In conclusion, the primary function of the process-control personnel is to maintain the conditions of operation which experience has proved to give satisfactory results. It is a common occurrence in the vitreous-enamelling industry for troubles to appear suddenly and disappear just as abruptly. This can only happen when some factor has varied in the materials or processing. The effectiveness of the process-control organization can be assessed by the competence with which it maintains standard procedure and the way it deals with any variations that occur.

Finally, acknowledgments are due to the directors of John Wright & Company, Limited, and J. A. Jordon & Company, Limited, for permission to present this Paper.

News in Brief

ASSOCIATED LEAD MANUFACTURERS, LIMITED, has taken over the old Mitford Street School, Newcastle-upon-Tyne, for the purpose of works extensions.

A CONTRACT valued at £250,000 from Yugoslavia to supply paper mill machinery to that country has been received by the General Engineering Company (Radcliffe), Limited, Radcliffe (Lancs).

IN THE FIRST HALF of this year Sheffield and district steel firms produced a weekly average of 44,000 tons of ingots and castings, against the corresponding figure for last year of 43,200 tons. Average weekly production in June was 43,000 tons, compared with 40,300 tons in June, 1951.

AT A MEETING at Birmingham last month, shop stewards of the Transport and General Workers' Union, representing 30,000 workers in the engineering and allied trades in the Birmingham district, passed a resolution supporting a demand for a wage increase "of a reasonable character."

A WAGE INCREASE of 12s. 6d. a week for draughtsmen of 21 and over with proportionate increases to tracers and to juvenile workers has been awarded by the Industrial Disputes Tribunal. The Association of Engineering and Shipbuilding Draughtsmen had claimed an extra 14s. a week for adult employees.

HUNGARIAN SOURCES announce that the production of aluminium ingots in Hungary during 1951 was 20 times greater than in 1938. In that year 549,000 tons of bauxite was extracted, of which only 6 per cent. was processed at home. The rest was exported, mainly to Germany. Most Hungarian mines were German owned.

JAMES HOWDEN & COMPANY (LAND), LIMITED, engineers, etc., of Glasgow, has taken over the old-established yacht-building and repairing firm of Morris & Lorimer, Sandbank (Argyle), which was founded in 1883 by the late Mr. Robert Lorimer, grandfather of the last owner. The business will be carried on for the time being under the existing name.

A MEETING has been arranged by the Iron and Steel Institute in conjunction with the British Iron and Steel Research Association to discuss papers on the corrosion of steel under phosphate coatings and protective finishes. It will be held at 4, Grosvenor Gardens, London, S.W.1, on Tuesday, October 28, commencing at 2 p.m.; Mr. H. T. Shirley, chairman of the corrosion committee of B.I.S.R.A., will be in the chair.

AS A RESULT of some redundancy in aluminium foundries in the area, and in an attempt to avert the consequences of the slump, Walsall Trades Council is asking Major W. T. Wells, M.P. for the Division, to press for the removal of the ban on exporting aluminium ingots. Trade circles, however, do not anticipate any success in the matter, pointing out that virgin aluminium has to be imported from Canada, a dollar area.

AT THEIR JULY MEETING, the Victorian division of the Institute of Australian Foundrymen heard a Paper on "Cupola Melting and Moulding of Medium-duty Cast Irons," by Mr. F. C. Eager, who is metallurgist, McPhersons, Limited. The annual convention of the division will take place on November 14 and 15, and will consist of discussions of papers together with a visit to one of Melbourne's leading foundries. It will conclude with the annual dinner.

IT WAS STATED recently by the Department of Scientific and Industrial Research that after 100 hours' continuous run at full power, the marine gas-turbine at the Wallsend-on-Tyne research station of the Parsons and Marine Engineering Research Association had been inspected and given a very satisfactory report. Fuel consumption had been very much lower than was expected. The turbine is designed for use in merchant ships and to have a life exceeding 100,000 hours.

THE AUSTIN MOTOR COMPANY, LIMITED, has appointed Mrs. Kay Petre, motoring consultant to Sidney-Barton, Limited, as woman adviser on colour schemes for their 1953 cars in the A30, A40 and A70 ranges. Mrs. Petre drove Austin cars in many races before the last war and recently has been in the United States studying the methods of automobile firms in Detroit as regards body styling. American firms retain women colour stylists because women so often choose the colour of the family car and the Austin Company is emulating American practice in this respect.

BIRLEC, LIMITED, Birmingham, has secured, against strong European competition, an order for the largest electric-arc melting furnace in Europe, the purchaser being Samuel Fox & Company, Limited, in association with United Steel Companies, Limited. The furnace is to have a capacity of 60 tons and a rating of 20,000 h.p. (15,000 k.v.a.), and will be used for producing high-quality alloy steels, particularly for jet-engine components. With a diameter of 19 ft., it will have a capacity 41 per cent. greater than that of any electric furnace in Europe. Furnaces of this size and kind have hitherto been made in America by Birlec's associate company, the Pittsburgh Lectromelt Corporation.

JOSEPH SANKEY & SONS, LIMITED, have abandoned the self-build housing scheme which they inaugurated earlier this year for the benefit of the firm's 4,000 employees at Bilston. Workers have found difficulty in putting in the stipulated 20 hours a week on the scheme and others have shown themselves chary of committing themselves to the costs. Bilston Corporation had allotted a site for the scheme, and arrangements had been made to waive development charges and to secure the necessary building licences. Free instruction in building method was to have been given to Sankey employees by representatives of the Wolverhampton Clerks of Works Association.

THE BRITISH ALUMINIUM COMPANY, LIMITED, has announced price reductions, amounting to 2d. a lb. or nearly 8 per cent. for bulk quantities, for the special range of thin-gauge sheet and coiled strip for boxmaking and capping purposes. The reductions come into effect on August 25 and follow the completion of substantial extensions to the company's Falkirk rolling mills, including the installation of new high-speed tandem and finishing strip mills specially designed for the economic production of this class of material. The new rolling equipment also makes possible the inclusion of a stronger alloy for boxmaking at prices previously charged for pure aluminium and 1¼ per cent. manganese alloy.

AMONG THE EXHIBITS of Sheffield manufacturers at the International Machine Tool Exhibition to be held in London, next month, will be a centenary exhibit of Samuel Osborn & Company, Limited. Craftsmen of the company, which celebrated its centenary last April, made the model by which the steelmaking methods of 1852 are contrasted with those of today. James Neill & Company, Limited, are exhibiting several magnetic devices new to the engineering industry, Sheffield Twist Drill & Steel Company, Limited, will be displaying 60 small tool types, and Firth Brown Tools, Limited, three new types of hardness-testing machine which can be taken to the job instead of taking the job to the testing bench.

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DRYING OUT

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'Resolite' 400 provides a protective oil-film which considerably reduces the loss of moisture by evaporation. It also provides lubrication between the grains of sand during mixing, and *prevents stickiness.*

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'RESOLITE' (REGD.) 400

SYNTHETIC RESIN CORE-BINDER

(Patent applied for)

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Raw Material Markets

Iron and Steel

Increased production of pig-iron is being maintained and there are good prospects of further expansion, as ore supplies are satisfactory and coke deliveries are improving. The achievement of the target for an increase of 1,000,000 tons in the year's output seems to be certain unless unforeseen difficulties should arise. The steelworks are benefiting by the extra supply of basic pig-iron, which is enabling more melting plants to be put into operation, but the acute shortage of scrap, however, is not yet fully covered by a proportionate tonnage of basic pig-iron and some steel producers report difficulty in obtaining sufficient supplies of raw materials to provide adequately for furnaces now operating, while many units remain idle.

Deliveries of pig-iron to the foundries show some improvement, but this is partly accounted for by the recent cut in licences, which has reduced demands on the producers, and most consumers are able to cover their allocated tonnages. The engineering and speciality foundries continue to utilize all the low- and medium-phosphorus irons which producers can offer and hematite is also fully absorbed. Some users of high-phosphorus pig-iron are calling for reduced quantities because of a slight recession in demands for light castings and for castings for textile machinery. Supplies of pig-iron all round are not yet sufficient for the accumulation of stocks of any magnitude. Scrap, too, is difficult to accumulate, particularly the heavier grades, although there is improvement in deliveries of the lighter material.

Many foundries would be relieved to see larger quantities of foundry coke in stock as a precaution against possible delivery hold-up later in the year. Ganister, limestone, and firebricks are received to requirements, while the foundries in need of ferro-alloys are generally able to obtain the quantities and grades required.

The re-rollers are now better placed for supplies of semi-manufactured steel. Deliveries from home sources are still confined to normal allocations and little, if any, excess tonnage can be secured, and the improved supply position is due mainly to increased deliveries of steel from abroad; there are prospects of further expansion in supplies from oversea before the end of the year. Demands for light sections, bars, and strip from home sources are heavy, but difficulty is experienced in disposing of export allocations, competition from oversea makers being favoured by the price differential. Sheet re-rollers are very busy on orders for home priority needs. Outputs have improved by the extra tonnages of sheet bars received from oversea. More steel semis are needed by the re-rollers, particularly the smaller sizes, to keep their mills fully operative and any grade of material suitable for conversion, including defectives and crops, is readily accepted.

Non-ferrous Metals

The Committee of the London Metal Exchange announced last week details of the dealing times in lead, so that another step has been taken towards the commencement of dealing on October 1. The new and revised contract for lead has now been issued, and it is interesting to note that the basis is to be refined lead of 99.97 per cent. purity. This will, of course, admit secondary refined metal produced from scrap, provided that the purity is up to the standard demanded by the market. Brands must be registered in accordance with the procedure laid down by the Committee of the Exchange and a fee will be required when registration takes place. Certainly no pains have been spared on the part of the Exchange to ensure success in this return to pre-war methods of marketing, and it is known that the Ministries concerned have been co-operating closely with the Committee.

At what level dealing will start, of course, remains to be seen, but it seems to be generally accepted that the opening bid will be well below £131. On the Continent the price to-day is in the neighbourhood of £115. In the meanwhile, consumers are buying cautiously and not displaying any inclination to take a forward view. Doubtless some users would be prepared to put metal on their books for October-November if they could obtain it at a substantial cut below the present ruling price. One thing is certain and that is the existence of very ample stocks of lead in the country, for the Government, it will be remembered, has something like 100,000 tons.

Tin lost ground last week following the recent rally on the market. Nothing definite has emerged regarding the negotiations between the Reconstruction Finance Corporation and the Bolivian producers, but doubtless the talks are going on. Recently there was a report that Bolivian interests are considering the erection of a tin smelter in that country. But, as in the case of Chile and copper, Bolivia must export her tin either as metal or concentrates, for the economy of the country makes this course essential.

London Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £955 to £957; Friday, £952 to £953; Monday, £953 to £954; Tuesday, £959 10s. to £960 10s.; Wednesday, £963 to £964.

Three Months—Thursday, £940 to £941; Friday, £939 to £941; Monday, £942 to £944; Tuesday, £948 to £948 10s.; Wednesday, £949 to £951.

Aluminium presents something of a puzzle at present for somewhat inexplicably demand in this country has declined of late, and yet there has been talk of a price increase. Last week, however, it was announced that there would be a reduction of 2d. per lb. in certain types of strip and sheet, so that the situation seems to be rather contradictory.

Iron-ore Imports

Imports of iron ore in July and the total for the seven months of the year to date, with comparative figures for 1951, are shown below.

Country of origin.	Month ended July 31.		Seven months ended July 31.	
	1951.	1952.	1951.	1952.
	Tons.	Tons.	Tons.	Tons.
Sierra Leone	63,620	85,680	307,993	468,128
Canada	95,185	126,095	167,070	358,268
Other Commonwealth countries and the Irish Republic ..	2,232	2,012	15,206	15,399
Sweden	396,152	372,333	1,823,113	2,112,511
Netherlands	6,214	7,379	19,894	21,354
France	25,493	31,330	227,360	246,667
Spain	85,090	62,918	488,352	428,172
Algeria	159,591	164,003	788,846	1,026,679
Tunis	66,506	56,560	297,751	325,611
Spanish ports in North Africa	25,750	18,350	202,356	182,967
Morocco	34,058	28,750	162,710	171,836
Other foreign countries	38,585	53,755	106,145	256,450
TOTAL	998,476	1,009,165	4,606,796	5,614,042

BRITISH RAILWAYS' winter train service will operate from September 15 until June 7 next year.

If saving costs is Important—
then this surely is an **IMPORTANT DEVELOPMENT!**

Since the introduction of our SUPINOL "7" Core Oil to a number of foundries—the reports from these foundries leave no doubt that this oil is equal in performance to the best on the market, and it shows a saving of 20% or more in cost. *There are no snags—no need to change from your present method of application—*

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CORE OIL

it will pay you to try it out!

The following is an extract from a report received from a large mechanised foundry:—
N.B.—Original report is filed in our Head Office.

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SUP...
be...
...d up to 5500° F.
The transverse test gave the highest figures, but both transverse and tensile figures were of the same order as those obtained with Pure Linseed Oil, although the figures obtained with Linseed Oil were slightly better than with your "SUPINOL"; also, the drying temperatures required to give maximum strength are rather lower with Linseed than with your Oil.
It would appear, however, that tech... ...ally SUPINOL "7" Oil could be ... as a ...artial substitute for Li...ed Oil."

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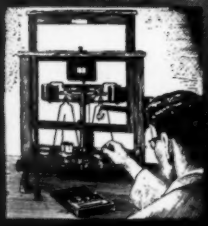

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

September 3, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 12s. 6d.; Birmingham, £14 19s.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr.: max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £43 15s. 2d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 6s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1¼d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £963 to £964; three months, £949 to £951; settlement, £963.

Zinc.—G.O.B. (foreign) (duty paid), £122; ditto (domestic), £122; "Prime Western," £122; electrolytic, £126; not less than 99.99 per cent., £128.

Lead.—Good soft pig-lead (foreign) (duty paid), £131; ditto (Empire and domestic), £131; "English," £132 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £142 15s.; rolled zinc (boiler plates), all English destinations, £140 15s.; zinc oxide (Red Seal), d/d buyers' premises, £142.

Other Metals.—Aluminium, ingots, £157; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 37½d.; sheets to 10 w.g., 31½d.; wire, 33d.; rolled metal, 30d.

Copper Tubes, etc.—Solid-drawn tubes, 32½d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £212 to £218; BS. 1400—LG3—1 (86/7/5/2), £235 to £239; BS. 1400—G1—1 (88/10/2), £352 to £375; Admiralty GM (88/10/2), virgin quality, £375 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £365 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb.(7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3¾d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9½d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8½d.; 15%, 4s. 2d.; 18%, 4s. 6½d. All prices are net.

Obituary

MR. ARTHUR CLAUDE CHURCHILL, a director of Brigham & Cowan, Limited, shiprepairers, etc., of South Shields (Co. Durham), has died at the age of 56.

THE DEATH occurred recently of MR. WILLIAM BROWN, who was formerly chief draughtsman of the North British Locomotive Company, Limited, Glasgow.

THE DEATH took place on August 24 of MR. THOMAS GUTHRIE YOUNG, managing director of Kerr & Company (Maryhill), Limited, ironfounders, of Glasgow.

MR. GEORGE BRAILEY WILLIAMS, chairman of John Williams & Sons (Cardiff), Limited, iron and steel stockholders, has died at the age of 76.

THE DEATH is announced of MR. F. FENN which took place recently. Mr. Fenn was one of the first executives to join I.T.D., Limited, and was responsible for producing the first Stacatruc fork-lift truck in 1946.

MR. WILLIAM MILLAN MACKIE, who has died at Milton, Northampton, at the age of 57, was educated at Falkirk and served his apprenticeship with the Carron Iron Company, subsequently entering the family business of Wm. Millan & Sons, engineers and coachbuilders. During the war he was a test inspector at the Hillington works of Rolls Royce and was associated with the production of the gas-turbine engine and with the developments at Barnoldswick and Newcastle-under-Lyme. In 1947 he joined the staff of the College of Aeronautics and his experience in the installation and development of testing techniques for gas-turbines and for their instrumentation proved highly valuable.

MR. DOUGLAS GEORGE J. W. MATHER, governing director of Mather & Smith, Limited, ironfounders, of Ashford, Kent, died on August 22, aged 61. Son of the late Mr. George Mather, he joined the firm as a boy, and was apprenticed in London and later with Smith & Company in South Shields. In 1919, he married Miss Edith Smith, a daughter of the head of the firm. In the 1914-18 war he was with the R.A.M.C., and rejoined the firm in 1919, succeeding his father as head in 1922. An active worker for the British Legion, he was for some years branch chairman and from 1945 the president. He was a member of the Ashford Urban District Council from 1935 to 1947, being vice-chairman from 1941 to 1945, and then chairman for two years. It was during this period that he took a leading part in the civil defence of the district, later as chairman of the Civil Defence Committee.

Recent Wills

LIEBERT, H. A. E., founder of John Holroyd & Company, Limited, machine tool manufacturers, etc., of Rochdale (Lancs) £29,312

ARCHDALE, FRANK, late managing director of James Archdale & Company, Limited, machine tool manufacturers, of Birmingham £147,460

COLLINGRIDGE, FRANK, retired managing director of Batchelor Robinson & Company, Limited, scrap merchants, etc., of Birmingham £60,020

BROWN, ALEXANDER, formerly technical managing director of Davidson & Company, Limited, engineers and ironfounders, of Belfast £72,711

HUMPHREYS, MRS. G. M., formerly a director of the Midland Fan Company, Limited, Birmingham, and of the B.I.F. Engineering Company (1940), Limited, Birmingham £2,570

LOW PHOSPHORUS
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ALLOYS & BRIQUETTES
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LIVERPOOL, 2. 13, Rumford St., Central 1558
GLASGOW, C.2. 93, Hope Street, Central 9969

NOTICE

Replies to Box Numbers to be addressed to "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

ASSISTANT METALLURGIST (29) seeks progressive situation, any area. Fully experienced laboratory, cupolas, rotary furnace, chilled and grey iron castings.—Box 2019, FOUNDRY TRADE JOURNAL.

CHEMIST-METALLURGIST, capable controlling Cupola and Converter plant, desires change to progressive firm seeking efficient and economic production by up-to-date ideas.—Write BM/LLKL, London, W.C.1.

METALLURGIST (32) desires position. Practical and technical experience in iron and steel plant management, physical and chemical laboratories, and sand control.—Box 2023, FOUNDRY TRADE JOURNAL.

ASSISTANT Iron Foundry MANAGER/METALLURGIST (28). All-round practical and technical experience in modern mechanised and general foundries. High duty irons, cupolas, sand. Any progressive position considered. Married; accommodation essential. — Box 1988, FOUNDRY TRADE JOURNAL.

METALLURGIST (23), possessing wide technical experience and accustomed to working on own initiative, requires post in non-ferrous foundry or allied trade. Midlands area.—Box 2024, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-54 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952

ESTABLISHED Iron Foundry, North Midlands, requires genuine active Partner, take full control, or sleeping Partner. Capital necessary £1/3,000. Excellent prospects.—Box 1997, FOUNDRY TRADE JOURNAL.

ASSISTANT FOREMAN, to take charge of a Machine and Floor Moulding Bay in Jobbing Foundry. Must have cupola knowledge. State experience and salary required.—Box 2011, FOUNDRY TRADE JOURNAL.

MANAGER wanted for modern Foundry in process of expansion. Highly qualified applicant only. Good salary to the right man.—Box 2022, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

REQUIRED.—DRAUGHTSMEN, with experience of gravity diecastings.—JOHN DALE, LTD., London Colney, St. Albans, Herts. Bowmansgreen 2266.

ASSISTANT FOREMAN take charge mechanised small castings bay and core shop, Bristol district. State experience and salary required.—Box 2008, FOUNDRY TRADE JOURNAL.

PATTERNMAKERS for expanding Foundry. Port rate and good bonus to suitable applicants.—G. P. WILSON (ENGINEERS) LIMITED, Northam, Southampton.

FOUNDRY FOREMAN, age 30/35, experienced in ferrous and non-ferrous machine moulding and jobbing practice, required for Middlesbrough foundry controlled by progressive engineering firm on North-East coast. Foundry has modern building and equipment.—Box 2007, FOUNDRY TRADE JOURNAL.

YOUNG METALLURGIST required primarily to control cupolas serving mechanised foundries in East Anglia. Applicants should have sound technical training. The vacancy has ample scope for man with initiative. Write, giving details of experience, education, age, and salary required.—Box 2017, FOUNDRY TRADE JOURNAL.

WANTED, for Shell Moulding Industry by leading firm in this field, METALLURGIST, able to write technical reports and with some experience of the foundry industry. Highest qualifications required. Age 30-35 years. Unique opportunity for applicant willing to devote himself to this rapidly expanding technique.—Apply, POLYGRAM CASTING CO., LTD., Power Road, Chiswick, W.4.

FOUNDRYMAN (NON-FERROUS).—An exceptional appointment, with definite advancement to an administrative position, is open to a man with practical training in mass-production of light and medium, pressure tested castings. Modern methods and ability to accept responsibility essential. Position suitable for man with ambition, and who already holds appointment as Foundry Manager or Assistant. Age not over 40. Superannuation available and house arranged for if necessary. Modern Factory situated in Glasgow district.—Box 2020, FOUNDRY TRADE JOURNAL.

FOUNDRY RATEFIXER required for an Engineering Works in the North-West. Must be fully experienced with foundry practices. Staff appointment; five-day week; canteen facilities.—Apply stating age and experience, to Box 2026, FOUNDRY TRADE JOURNAL.

AGENCY

SOUTH WALES AND THE WEST OF ENGLAND. — Technical REPRESENTATIVE (A.M.I.B.F.), 10 years' successful record, and with wide connections amongst the foundry, steel, and engineering industries in the area, now commencing on own account as Sales with Service Agency, seeks two only first-class Companies, on commission terms. Own car, telephone, office. Stockroom if required. Excellent references.—Box 2021, FOUNDRY TRADE JOURNAL.

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PURE AND APPLIED CHEMISTRY including courses in preparation for the A.R.I.C., L.I.M., and A.I.M.; the C. and G. examinations in Fuel Technology, Metal Finishing, Electrodeposition, Metallurgy and Boiler House Practice.

Other courses in Chemical Engineering, Glass Technology, Scientific Glassblowing, Clay Technology and Scientific German.

A special course on "Refractories" commences Tuesday, September 30th.

Enrolments: 15th—17th Sept. inclusive. (New students: 17th Sept. only.)

Full particulars available on application to the Northampton Polytechnic.

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30-TON capacity Bottom Pouring Steel Ladle urgently required.—Full details to Box 2013, FOUNDRY TRADE JOURNAL.

TRANSFORMER REQUIRED. 200-300 KVA, 6,600 to 500 volts, three phase, 50 periods. 25-50 KVA, 6,600-220 volts, three phase, 50 periods.—Box 2015, FOUNDRY TRADE JOURNAL.

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CUPOLAS, CRANES, MOULDING MACHINES, CONVEYORS, FURNACES and MACHINE TOOLS urgently required.
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